



National Aeronautics and  
Space Administration

JSC-16254-G

MAY 1984

SQT

Lyndon B. Johnson Space Center  
Houston, Texas 77058

(NASA-TM-87424) LIFE SCIENCES FLIGHT  
EXPERIMENTS PROGRAM. LIFE SCIENCES  
LABORATORY EQUIPMENT (LSLE) DESCRIPTIONS  
(NASA) 97 p

N85-71869

00/51 Unclas  
17754

LIFE SCIENCES FLIGHT EXPERIMENTS PROGRAM  
LIFE SCIENCES LABORATORY EQUIPMENT  
(LSLE) DESCRIPTIONS



LS-30013-G

# PROJECT DOCUMENT APPROVAL SHEET

REPORT NUMBER	LS-30013-G	DATE	May 21, 1984	NO. OF PAGES	90
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**TITLE:**

LIFE SCIENCES FLIGHT EXPERIMENTS PROGRAM  
LIFE SCIENCES LABORATORY EQUIPMENT  
(LSLE) DESCRIPTIONS

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APPROVED:		
APPROVED:		
APPROVED:		

DATE	PREPARED BY	CHANGE APPROVALS	CHANGE NUMBER



## LSPD DOCUMENT CHANGE/REVISION LOG

Page 1 of 2DOCUMENT NUMBER LS-30013

CHANGE LETTER	DATE	DESCRIPTION OF CHANGE	PAGES AFFECTED
A	12/04/79	Remove "Treadmill" and insert "Utensil Hand/Cleaning Fixture."	i
A	12/04/79	Add to the catalog Echocardiograph (page 57), Electrode Impedance Meter (page 58), Slide Staining System (page 59) and Vacuum Interface Panel (page 60).	ii, 57, 58 59, 60
A	12/04/79	Clarifications of the Orbiter Centrifuge specifications.	5
A	12/04/79	Changes made in the weight and rotor capacity of the Rack Mounted Centrifuge.	6
A	12/04/79	Change the Heart Beat Range on the Cardiotachometer from 20-100 bpm to 20-240 bpm.	25
A	12/04/79	Add to the description the sentence "The device will have a variable heat control, capable of maintaining the range $1^{\circ}\text{C} \pm 0.25^{\circ}\text{C}$ above ambient to $45^{\circ}\text{C} \pm 0.25^{\circ}\text{C}$ throughout the incubator."	28
A	12/04/79	Utensil/Hand Cleansing Fixture	31
A	12/04/79	Change the Heart Rate Control Range of the Bicycle Ergometer from 80-200 bpm to 40-200 bpm	33
A	12/04/79	Additions to the Specifications of the Doppler Blood Flowmeter are Output Signal, Power and Crystal frequency.	39
A	12/04/79	Add to the "Additional LSLE Equipment List" the Rack mounted centrifuge modification for refrigeration capability, Fluid Handling Kit, and Fecal Collection System.	45
A	12/04/79	Change the outside overall diameter clearance and all of the inside clearance dimensions of the LSLE Stowage Container-002.	55
B	04/21/80	This document is a complete revision of JSC 16254 Rev. A (LS-30013-B) and supercedes all information contained therein.	A11
C	08/24/82	Complete revision to reflect major changes	ALL

Altered Pages Must be Typed &amp; Distributed for Insertion

DOCUMENT NUMBER LS-30013		LSPD DOCUMENT CHANGE/ REVISION LOG		PAGE <u>2</u> OF <u>2</u>
CHANGE/ REVISION	DATE	DESCRIPTION OF CHANGE	PAGES AFFECTED	
D	9/20/81	Complete revision to make minor changes and to make improvements in quality of photographs.	ALL	
E	1/25/83	General periodic update	ALL	
F	10/12/83	Complete revision to include power profiles, J051 and E033.	ALL	
G	5/21/84	General periodic update	ALL	
<p style="text-align: center;"><i>Altered pages must be typed and distributed for insertion.</i></p>				

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## INTRODUCTION

The Life Sciences Flight Experiments Program provides Life Sciences Laboratory Equipment (LSLE) for use during inflight investigations. LSLE is comprised of scientific equipment, supplies, etc., which are utilized wherever possible to reduce new equipment development and program costs.

An inventory of space-qualified LSLE items is acquired and maintained by NASA for selection and integration into the various flight laboratory designs. After each laboratory flight, the LSLE items will be recovered, recertified, and returned to storage for reuse in subsequent flight laboratories.

This document status contains descriptions of LSLE which is or will be available to support the Life Science Flight Experiments Program. The hardware specifications for some items are design parameters and may change slightly through the development phase. Investigators may request the use of this hardware for the development and operation of their experiment. NASA will provide a technical representative who will assist each investigator in the integration of LSLE with their experiments by providing required operating procedures. Because the number of each type of LSLE is usually in the range from 2 to 6 items, the availability for use by a requester is contingent on previous commitments to the Life Science Flight Experiments Program.

TITLE: MINIOSCILLOSCOPE

STATUS: COMPLETE

CATALOG NUMBER: J001

DEVELOPMENT CENTER: JSC

PART NUMBER: JSC SED15550249-301

DESCRIPTION: The minioscilloscope is a general purpose, dual trace, storage oscilloscope, modified Tektronix Model 214. It is used to measure, display, and record transient voltage and electrophysiological signals from a variety of sources. In addition, it may be used as a general purpose diagnostic tool in maintaining other equipment.

INVENTORY: Five Flight Units

TECHNICAL SPECIFICATIONS:

Bandwidth:	DC to 500 kHz from 10 mV/div to 50 V/div, reducing to at least 100 kHz at 1 mV/div. Lower -3 dB point AC coupled is less than 2 Hz.
Deflection:	1 mV/div to 50 V/div. (1-2-5 sequence), accurate <u>+5%</u> .
Display Modes:	Ch 1 only, Ch 2 only, or Ch 1 and Ch 2 chopped with chop rate of 40 kHz from 500 ms/div to 2 ms/div of time base, alternate from 1 ms/div to 5 s/div of time base.
Input R and C:	1 Mohm paralleled by approximately 160 pF from 1 mV/div to 50 mV/div; and 140 pF from 100 mV/div to 50 V/div.
Maximum Input:	1 mV/div to 50 mV/div - 600 V (DC + peak AC) AC not over 2 kHz 0.1 V/div to 50 V/div - 600 V (DC + peak AC).
Time Base:	5 microsec/div to 500 ms/div, accurate <u>+5%</u> .
Horizontal Input:	(Ch 1) 1 mV/div to 50 V/div <u>+10%</u> ; DC to 100 kHz: X-Y phasing to 5 kHz less than 3°. Max Input 50 V (DC + peak AC). 100 V p-p.

#### TECHNICAL SPECIFICATIONS:

Trigger:

Automatic, normal, DC  
coupling to 500 Hz.  
Internal - 0.2 div.  
External - 1 V to 20 V p-p.

Display:

80 div/ms normal, bistable  
storage, 6 x 10 div.  
500 div/ms enhanced single  
sweep.

#### ENGINEERING DATA:

Power:

Lithium bromine or zinc-air  
batteries.

Dimensions:

26.9 L x 13.1 W x 7.3 H cm.

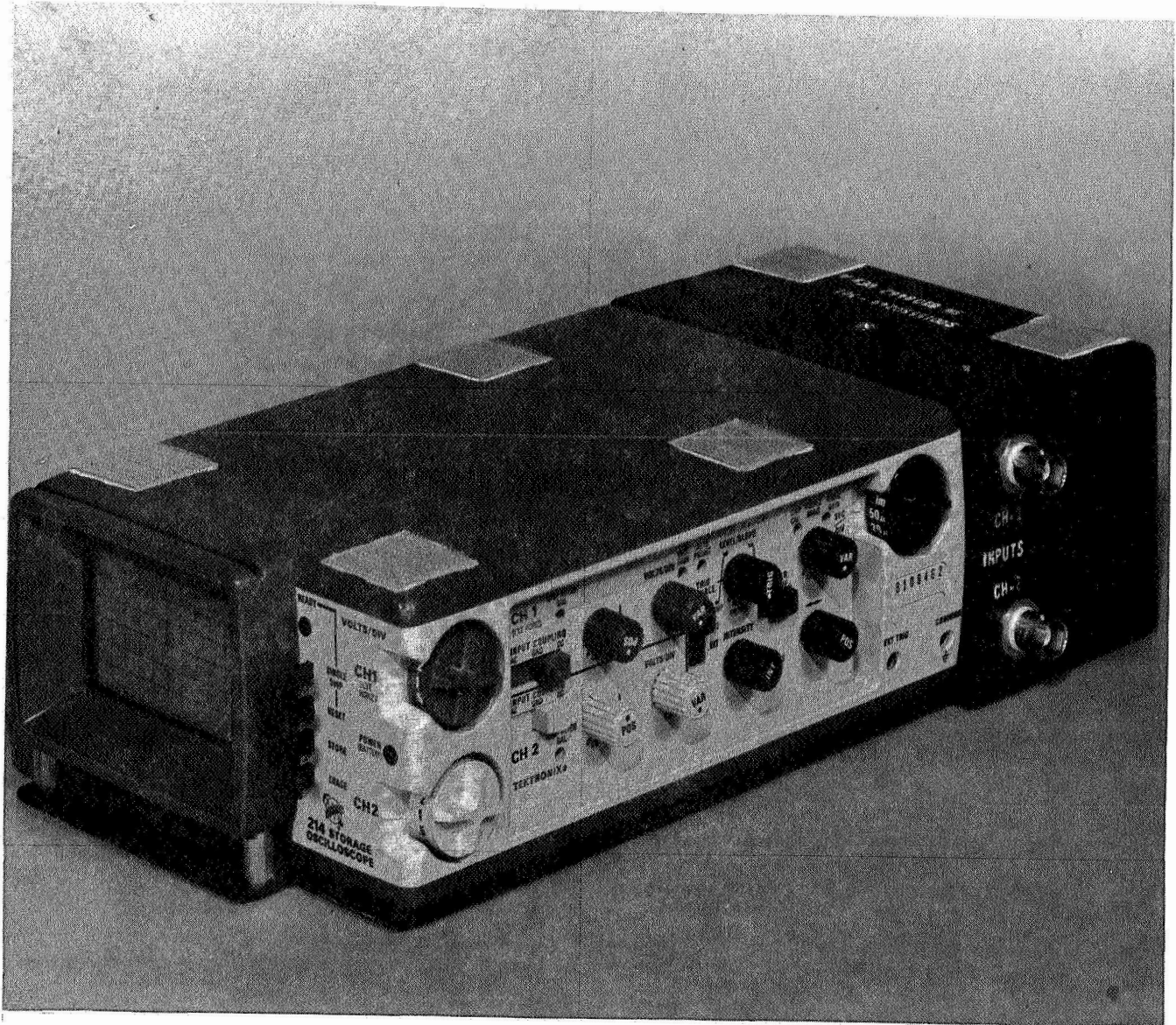
Mass:

1.9 kg.

Volume:

$2.57 \times 10^{-3} \text{ m}^3$ .

## Minioscilloscope





TITLE: MICROCOMPUTER

STATUS: COMPLETE

CATALOG NUMBER: J002

DEVELOPMENT CENTER: JSC

PART NUMBER: LE109587

DESCRIPTION: The low power 12 bit microcomputer is designed as a stand-alone computer for use with onboard experiments. A flexible system design allows the experimenter to use the microcomputer to accomplish a variety of experiment computer operations and to interface with Spacelab data systems for telemetry and/or onboard interaction.

Features of the microcomputer include:

- o Microprocessor based system
- o Complementary metal oxide semiconductor (CMOS) architecture
- o Digital data input capability
- o Analog data input capability
- o Programmable input/output (I/O)
- o Large memory capability
- o User programmable memories
- o Modular software package
- o Ground support software/hardware development system
- o Interface to onboard computer system through remote acquisition units (RAU's)
- o Interface to high rate multiplexer (HRM)

The system contains slots for 21 cards including cards for the central processing unit (CPU), power supply, analog/digital converters, digital/analog converters, direct memory access (DMA), multiplexer memory, read-only memory (RAM), erasable programmable read-only memory (EPROM), front panel control, HRM, RAU command, RAU data, and parallel I/O.

Data acquisition capability is available for both analog and digital signal sources. Downlink of data to the ground can be accomplished using the microprocessor interfaces with the Spacelab HRM and with the Spacelab experiment computer RAU's.

Some examples of uses are:

- o Real-time experiment control/operation
- o Onboard processing of data
- o Formatting of data for transmittal to the ground

INVENTORY: Eight Flight Units

TECHNICAL SPECIFICATIONS:

Memory:

Mixture of RAM and EPROM.  
32 K words maximum memory.

CPU architecture:

Based on Intersil IM6100 chip.  
Emulates PDP 8/E.

## TECHNICAL SPECIFICATIONS (Cont'd):

Clock speed:	2 MHz, programmable to 4 MHz.
Analog input:	16 differential inputs (32 single ended with common). 12 bit resolution. Conversion rates at 5,000 to 25 sps and single samples. Jumper selectable input ranges (0 to 5 V, 0 to 10 V, -5 to +5 V, -10 to +10 V).
Digital/Analog output:	4 channels. 500 conversions per second. Output levels jumper selectable (0 to 5 V, 0 to +10 V, -2.5 to +2.5 V, -5 to +5 V, -10 to +10 V).
Parallel I/O:	Optically isolated-full handshaking signals. Transfer rate - 5,000 sps. 12 bit transfer.
Serial I/O:	RS 232 compatible. Rates - 100 to 9,600 baud - selectable.
Real-time clock:	Software controllable. 2 MHz crystal. 1024 kHz crystal.
Front panel:	Full panel 12-bit switch reg/front panel displays/control remote panel 4-bit switch reg/run indicator/limited control.

## ENGINEERING DATA:

Panel units:

Interfaces:

To Spacelab experiment computer  
RAU and Spacelab HRM.

Power input:

28 VDC, 8 W (mission dependent).

Size:

42.5 L x 43.5 W x 17.7 H cm.

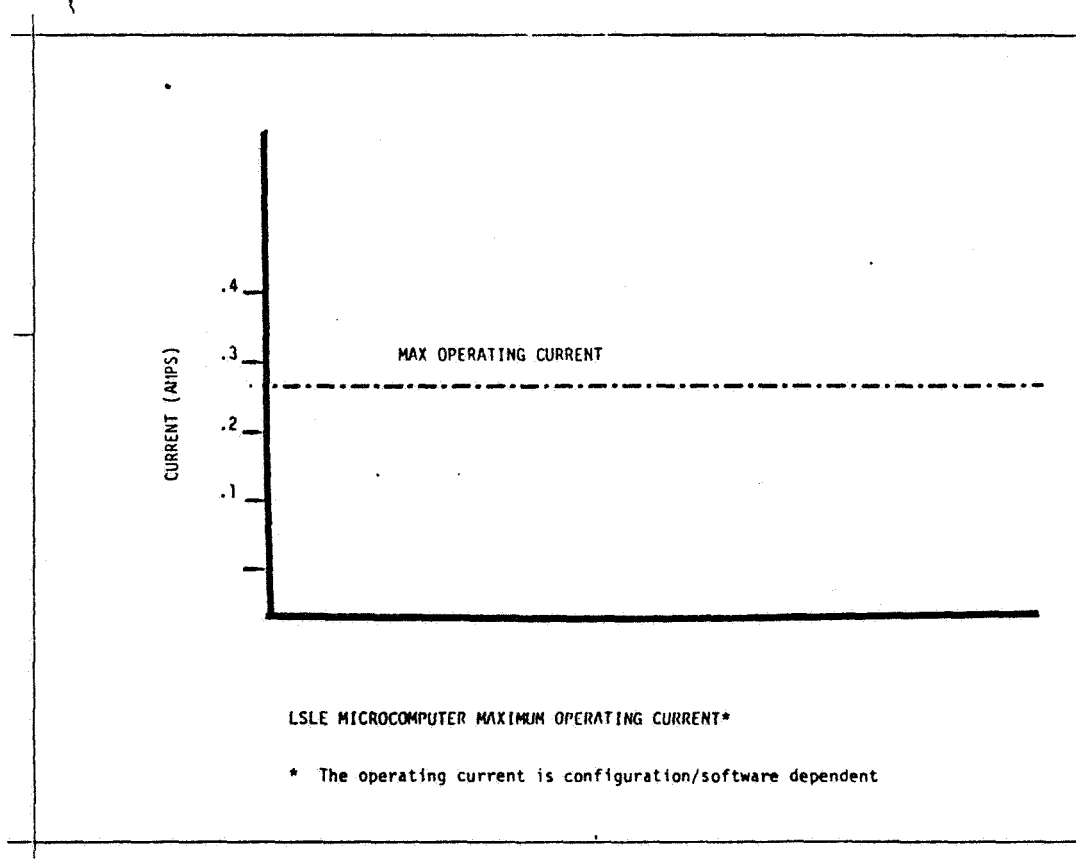
Volume:

$3.12 \times 10^{-2} \text{ m}^3$ .

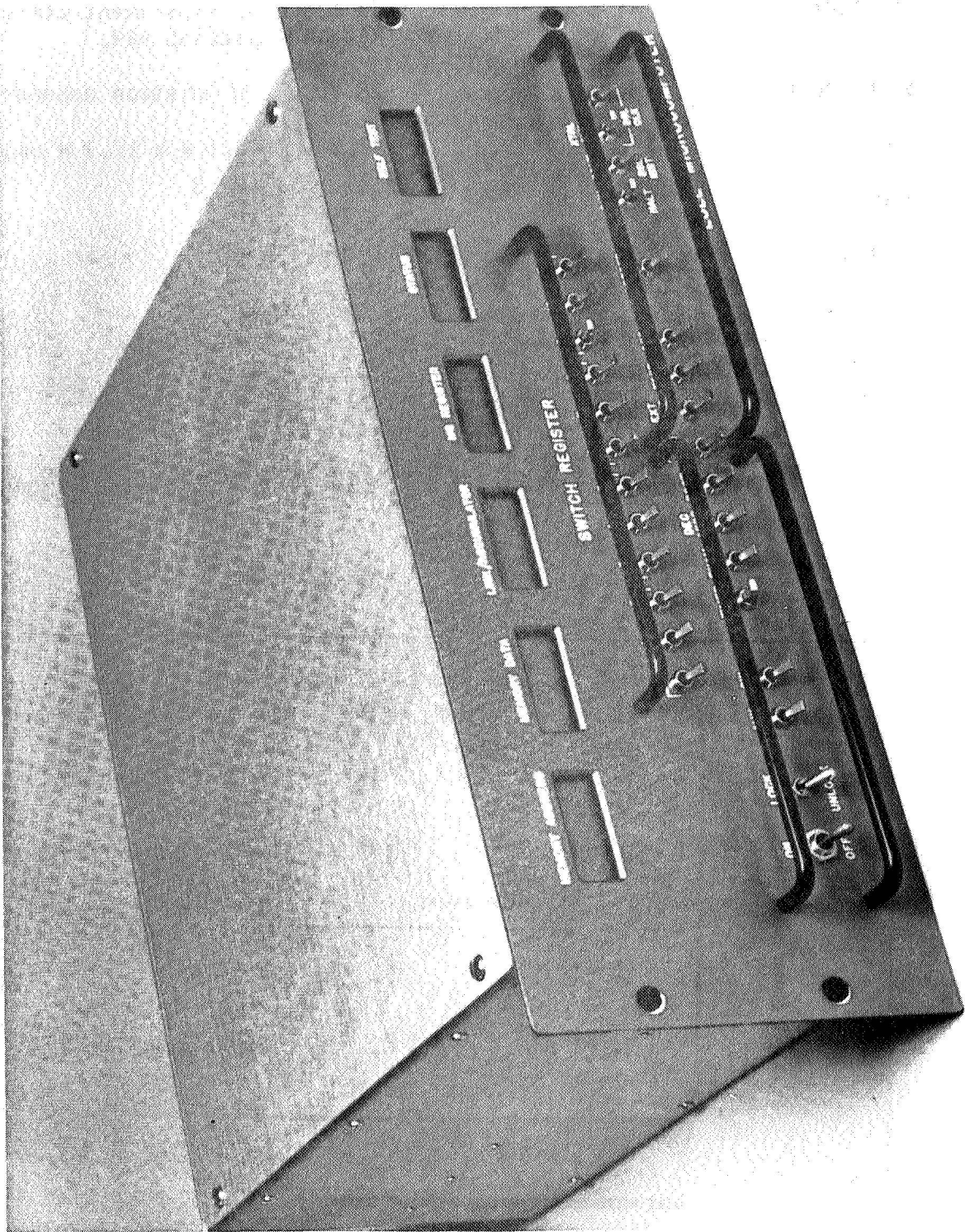
Weight:

10 kg.

## POWER PROFILE:



## Microcomputer



TITLE: RACK MOUNTED CENTRIFUGE

STATUS: COMPLETE

CATALOG NUMBER: J003

DEVELOPMENT CENTER: JSC

PART NUMBER: JSC SED32101057-302

DESCRIPTION: The general purpose, rack-mounted centrifuge (RMC) provides centrifugal acceleration for separation or processing of samples in hematology, bacteriology, microbiology, immunology, and other Life Sciences disciplines. The system consists of a variable speed DC motor to drive a rotor containing the specimens. It is installed in the Spacelab experiment rack and has mechanical and electrical interfaces with the rack. A number of rotors and tubes may be stowed depending on the particular payload requirement.

Two types of rotors are provided. One bucket type rotor for specimens requiring 50 to 1600 x g for acceleration, and 35° fixed angle rotors for accelerations to 4000 x g. Control and timing circuit is provided to control the variable speed and duration of centrifugational. Protection circuitry prevents excessive speed or damage to the rotor caused by unbalance.

The nominal specimen capacity of the RMC is:

<u>Tube Size</u>	<u>Quantity</u>
10 ml	48 Bucket rotor or 24 fixed angle rotor
15 ml	48 Bucket rotor or 24 fixed angle rotor
50 ml	10 Fixed angle rotor

INVENTORY: Two Flight Units

#### TECHNICAL SPECIFICATIONS:

Time, adjustable:	Up to 60 min.
Bucket rotor acceleration:	50 to 1600 x g, 48 10 or 15-ml cap.
Fixed angle (35°) rotor acceleration:	35 to 4000 x g, 10 50-ml cap. and 24 10 or 15-ml cap.

# ENGINEERING DATA:

Dimensions:

Volume:

Panel units:

Weight:

Power:

63.5 L x 42.8 W x 31 H cm.

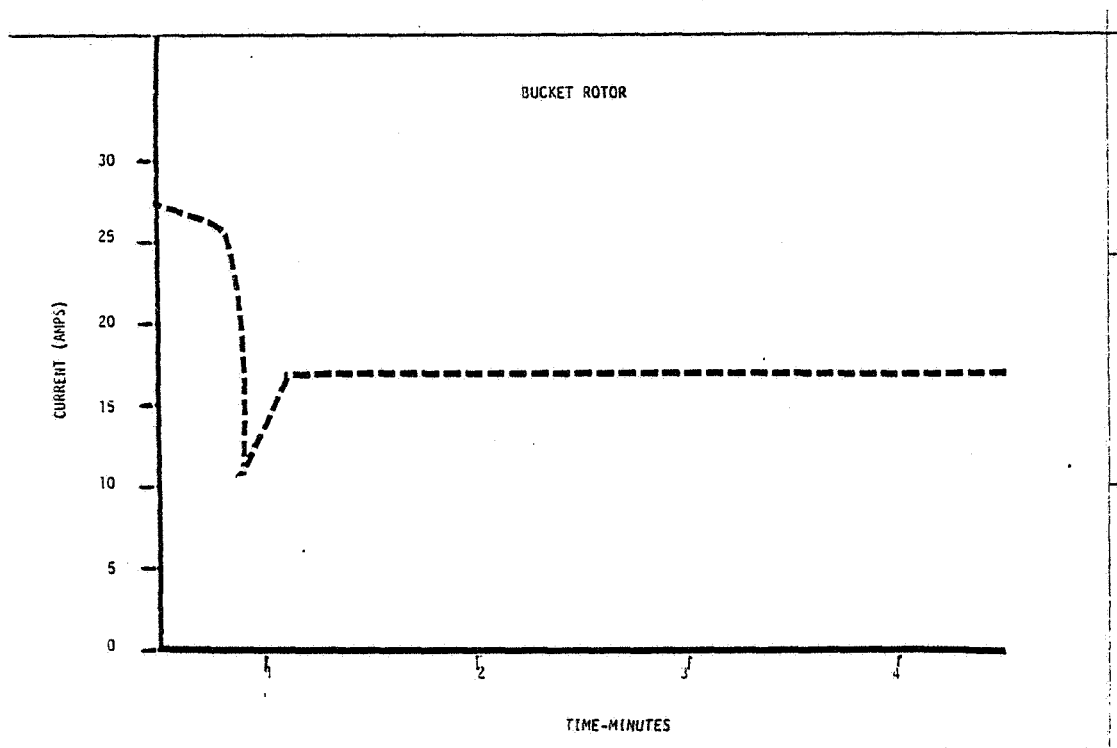
$7.38 \times 10^{-2} \text{ m}^3$ .

7

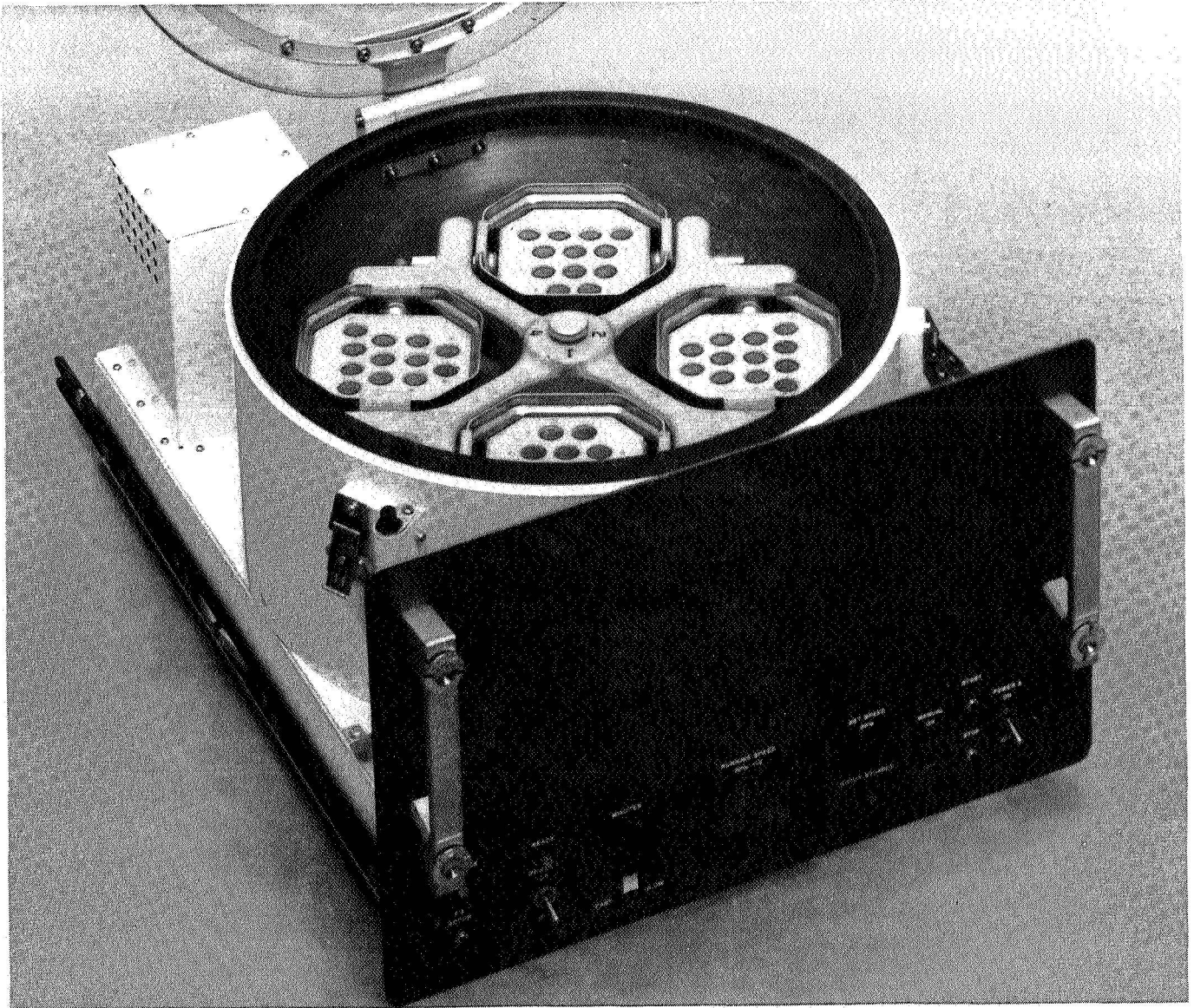
30 kg max. (fixed angle  
rotors, 6.5 kg each).

28 VDC, 480 W max. Rack

## POWER PROFILES:



## Rack Mounted Centrifuge



TITLE: SL-1 INFLIGHT BLOOD COLLECTION SYSTEM

STATUS: COMPLETE

CATALOG NUMBER: J005

DEVELOPMENT CENTER: JSC

DESCRIPTION: The inflight blood collection system (IBCS) contains clinical and medical laboratory equipment to collect inflight blood samples from the Shuttle crew. In addition, the IBCS has a limited laboratory capability for inflight measurements of hemoglobin and hematocrit and for making blood smears. The IBCS will be stowed in a Spacelab stowage container with slide-out access to the various foam kits. The hematocrit centrifuge and spectrophotometer (for measuring hemoglobin) will be stowed with the IBCS.

Features of the IBCS include:

- o Unique packaging system
- o Flexible design
- o Easy to use
- o Comprehensive

The IBCS contains large (15 ml) and small (10 ml) Corvac vacutainer syringes, monovettes (5 ml), infusion sets (19 ga), alcohol wipes, cotton balls, a tourniquet, spot bandaids, tape, glute tubes, vacutainer holders, minispectrophotometer, hematocrit centrifuge, slide stainer, forceps, surgical tape, multiple sample valves, pipettes, and marking pen.

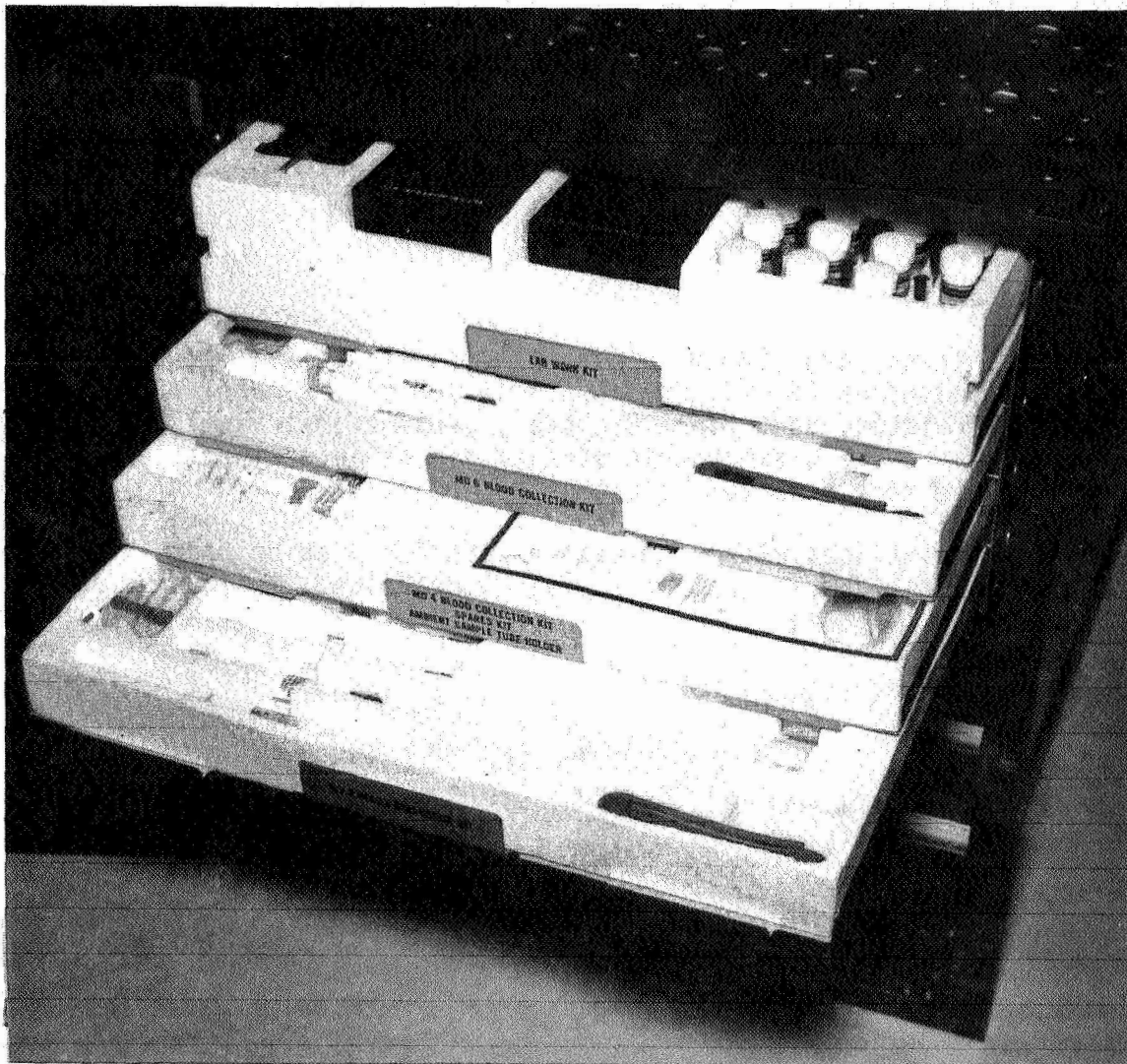
The SL-1 IBCS includes blood collection kits for mission days 2, 4, and 6, a work kit, spares, and an ambient storage tube holder.

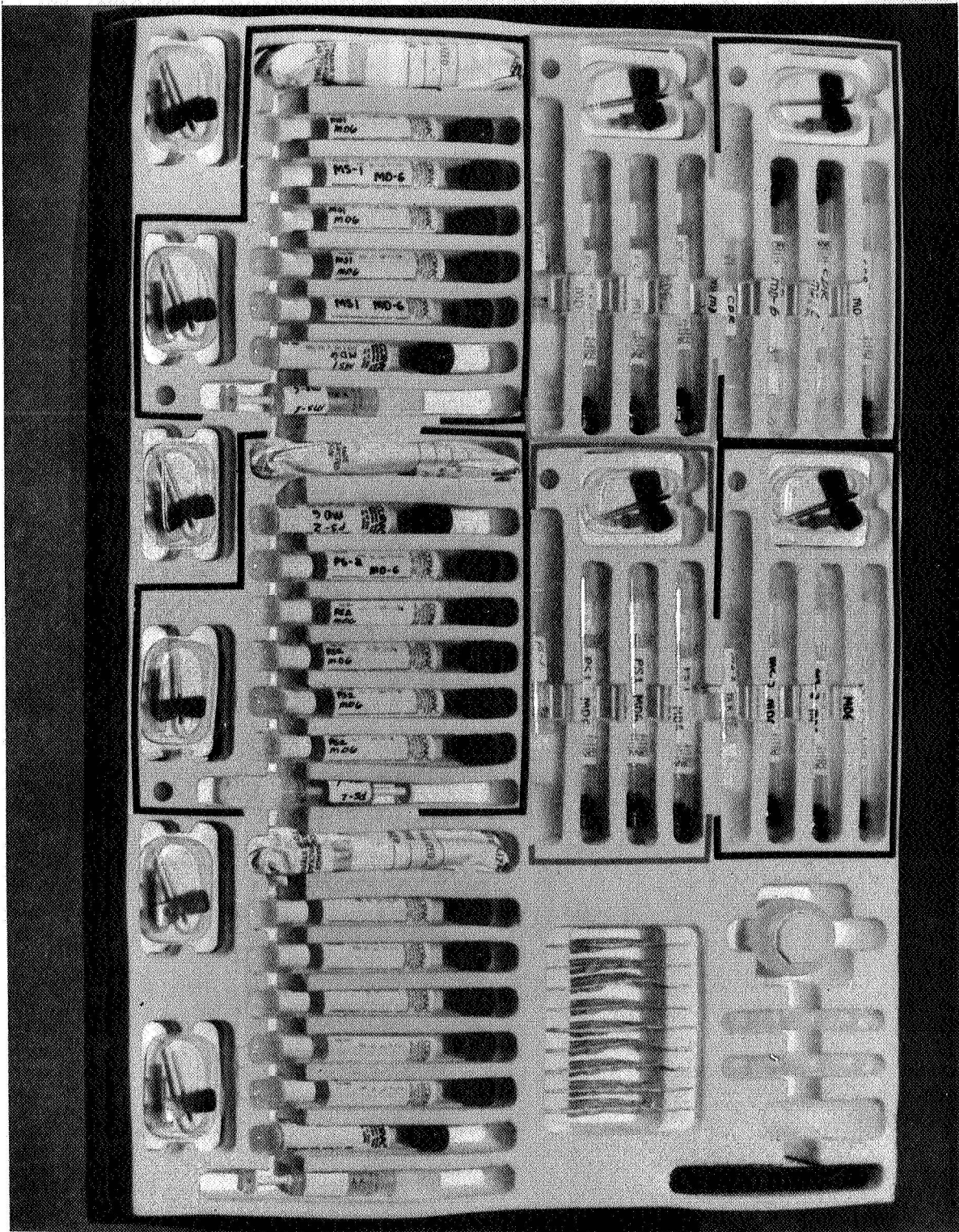
#### ENGINEERING DATA:

Power:	No Spacelab power required.
Volume:	Mission dependent (4.69 x 10 <sup>-2</sup> m <sup>3</sup> for SL-1).
Mass:	Mission dependent (8 kg for SL-1).
Dimensions:	58.42 L x 41.34 W x 20.32 H cm.

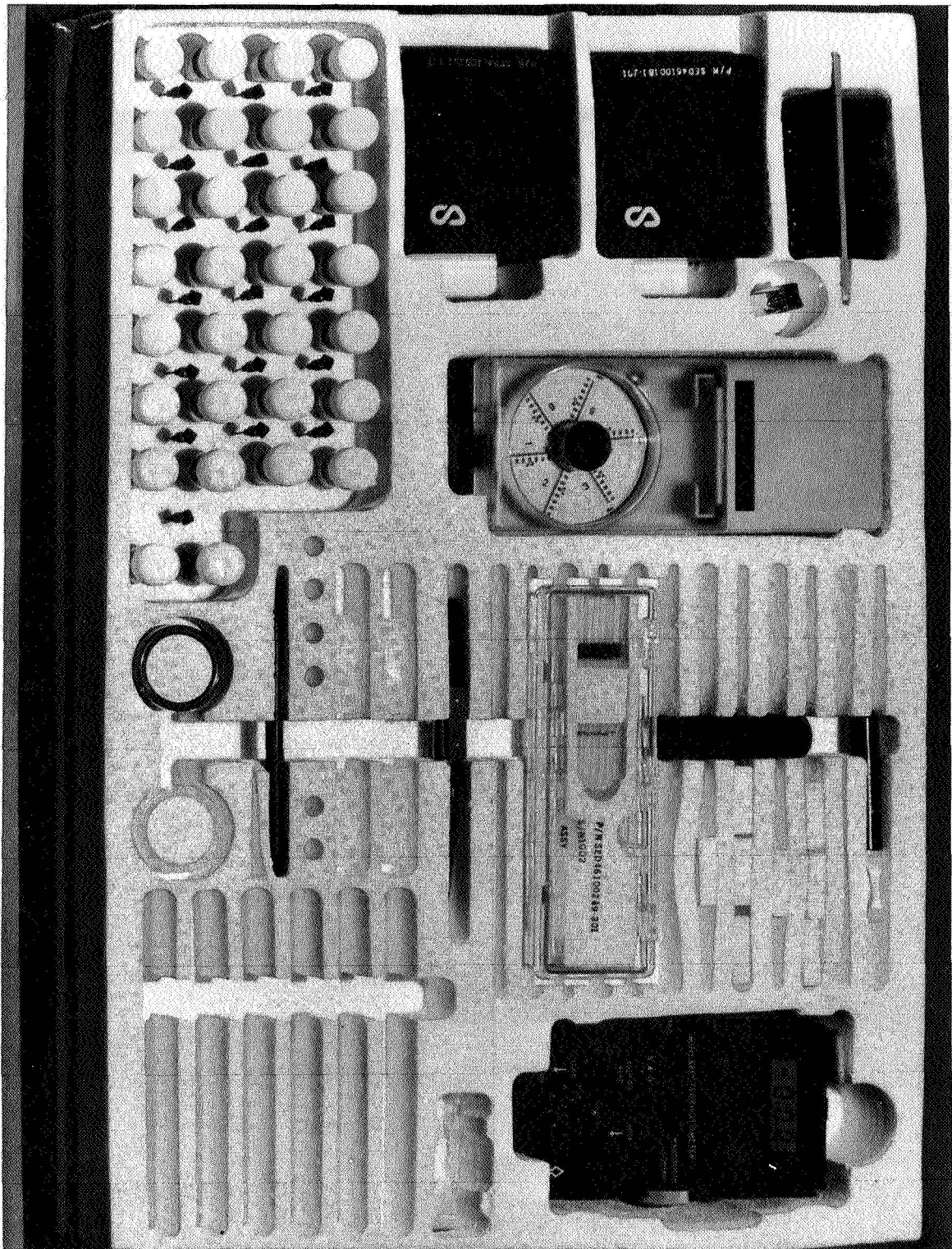


## SL-1 Inflight Blood Collection System









TITLE: SMALL MASS MEASUREMENT INSTRUMENT \*

STATUS: COMPLETE

CATALOG NUMBER: J006

DEVELOPMENT CENTER: JSC

PART NUMBER: SWRI 5618-001-01

DESCRIPTION: The Small Mass Measurement Instrument (SMMI) will measure solid, semisolid, and liquid masses plus small laboratory animals. A few examples of these masses are food, urine, feces, organs, rats, mice, powdered chemicals, tissue samples, and water. The range of the SMMI is 1 g to 10 kg.

Mass is determined nongravimetrically by timing the oscillations of a linear spring/mass pendulum. It consists of a spring loaded plate fulcrum platform with a digital display of mass. The SMMI will be rack mounted and will utilize the 28 VDC power supply.

INVENTORY: Three Flight Units

TECHNICAL SPECIFICATIONS:

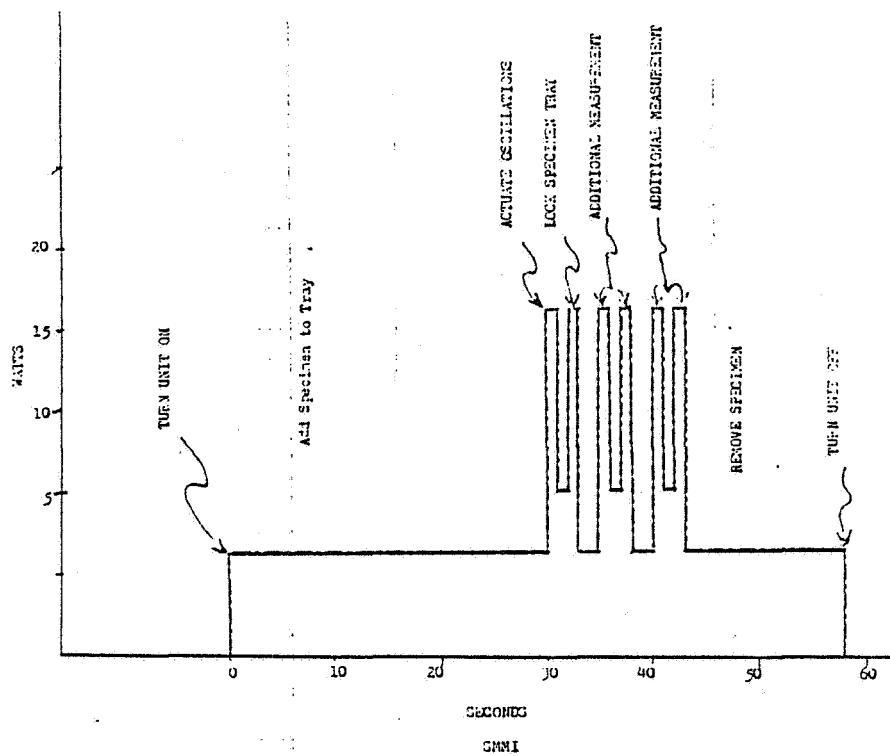
<u>Range:</u>	<u>Mass Accuracy</u>
1 g-25g	<u>+0.025 g</u>
25 g-2kg	<u>+0.5 g</u>
2 kg-10 kg	<u>±5.0 g</u>

\*AVAILABLE FROM: Life Science Flight Experiments Project Office  
(Org.Code LBE) Ames Research Center  
NASA  
Moffett Field, California 94035

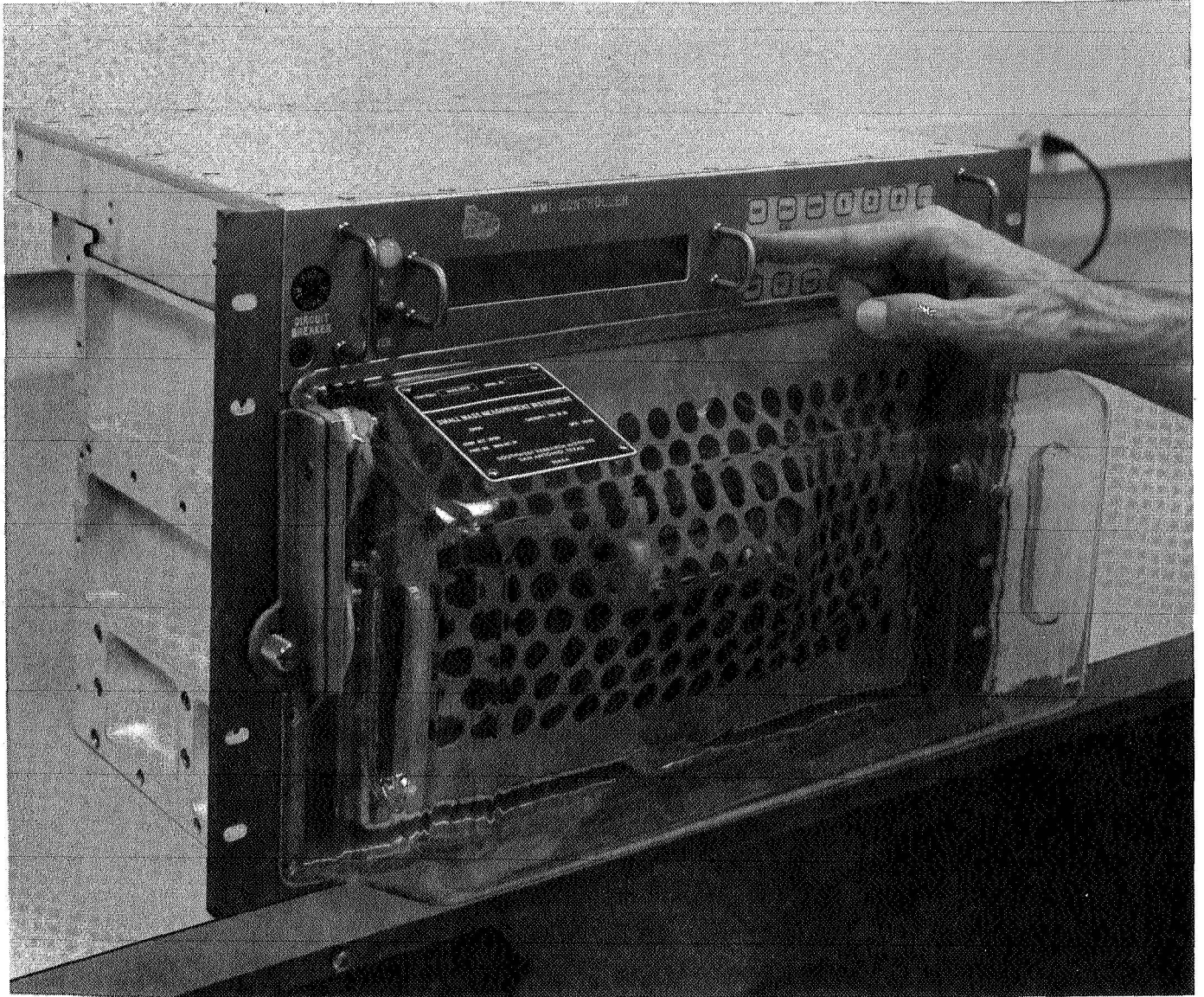
# ENGINEERING DATA:

Mass: 17 kg (max).  
Volume:  $3.87 \times 10^{-2} \text{ m}^3$ .  
Power: 28 VDC/15 W.  
Dimensions: 45.7 L x 48.3 W x 31.0 H cm.  
Panel units: 7.

## POWER PROFILE:



# Small Mass Measurement Instrument



TITLE: GAS ANALYZER MASS SPECTROMETER

STATUS: IN TEST

CATALOG NUMBER: J007

DEVELOPMENT CENTER: JSC

PART NUMBER: PERKIN ELMER 351100-001

DESCRIPTION: The Gas Analyzer Mass Spectrometer (GAMS) is a flight qualified analytical instrument which can support a wide variety of experimenter's research requirements in the Spacelab. The instrument will be used to perform atmospheric environmental monitoring of the cabin atmosphere or specimen holding facilities and to analyze astronaut or specimen inspired and/or expired gases. It can be used with other instruments to determine oxygen consumption and metabolic rate, respiratory dead space, residual capacity, pulmonary capillary blood flow, pulmonary diffusing capacity, cardiac output, and blood gas analysis.

The GAMS is capable of monitoring up to nine preselected low molecular weight gases at defined mass numbers. The system is designed to monitor nitrogen, oxygen, carbon dioxide, water vapor, isotopic carbon monoxide, nitrous oxide, argon, helium, acetylene, and total hydrocarbons (M/E 50 to 120). Gas samples are transferred to the instrument from an experiment by means of a sample transport line approximately 2 meters in length.

The GAMS is a fast response time, 60° magnetic sector, mass spectrometer compatible with cardiopulmonary applications. Design specifications of partial pressure ranges, response time, accuracy, stability, and repeatability are shown in table 1. There are two modes of analyzer operation. An open loop mode provides output levels independent of total cabin or partial pressure of the fractional pressure and is scaled by the experimenter. A closed loop mode provides output levels which are automatically scaled to the partial pressure of each fraction and the total cabin pressure. The output of the GAMS consists of an analog signal for each fraction being measured, analog signals corresponding to ambient total pressure and ion pump current, discrete signal levels for operational status, and a digital panel meter to display any one of the analog signals.

Features of the GAMS are:

- o Open or closed loop operating modes (selectable)
- o Primary and secondary filaments (selectable)
- o Self-protect inhibition circuitry
- o Digital display with selectable output.

The instrument monitors simultaneously up to nine low molecular weight gases, measures total pressure, and is compatible with Spacelab interfaces.

INVENTORY: Three Flight Units

# TECHNICAL SPECIFICATIONS:

Sample interface: 2 meter flexible capillary line (3 mm OD).

Operational life: 1500 hours.

Output:

- one analog line for each of the nine gases analyzed.
- total ambient pressure and ion current.
- digital display.
- one analog line for total hydrocarbon (M/E 50 to 120).

Table 1. Design Specifications for GAMS

Species Monitored	N <sub>2</sub>	O <sub>2</sub>	CO <sub>2</sub>	H <sub>2</sub> O	C <sup>18</sup> O
Max. partial pressure (torr)	800	800	150	50	10
Response time (sec)	.125	.125	.125	TBD	.250
Accuracy (FS)	<u>+1%</u>	<u>+1%</u>	<u>+1%</u>	<u>+5%</u>	<u>+5%</u>
Stability over 3 hours	<u>+0.3%</u>	<u>+0.3%</u>	<u>+0.3%</u>	<u>+0.6%</u>	<u>+1.25%</u>
Repeatability 30 day period	<u>+0.5%</u>	<u>+0.5%</u>	<u>+0.5%</u>	<u>+1.2%</u>	<u>+2.5%</u>
Species Monitored	N <sub>2</sub> O	A	He	C <sub>2</sub> H <sub>2</sub>	THC
Max. partial pressure (torr)	80	100	100	20	80
Response time (sec)	.125	.125	.125	TBD	TBD
Accuracy	<u>+5%</u>	<u>+5%</u>	<u>+5%</u>	<u>+5%</u>	<u>+5%</u>
Stability over 3 hours	<u>+0.5%</u>	<u>+1%</u>	<u>+1%</u>	<u>+0.5%</u>	<u>+0.5%</u>
Repeatability 30 day period	<u>+1%</u>	<u>+2%</u>	<u>+2%</u>	<u>+1%</u>	<u>+1%</u>

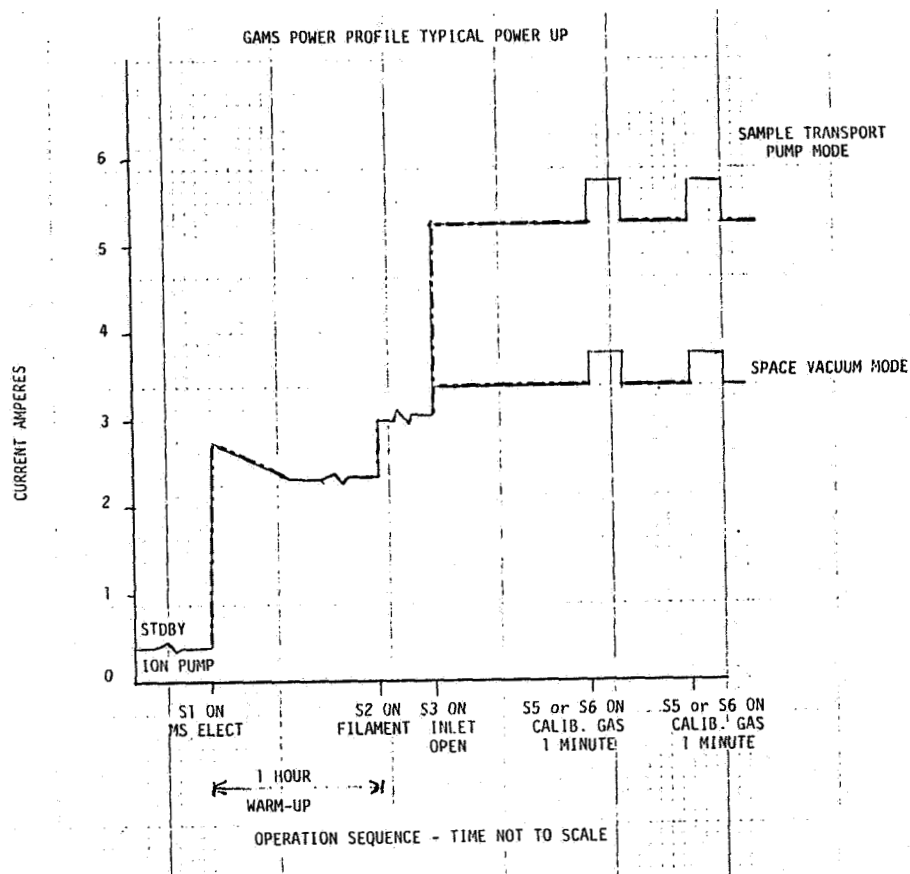


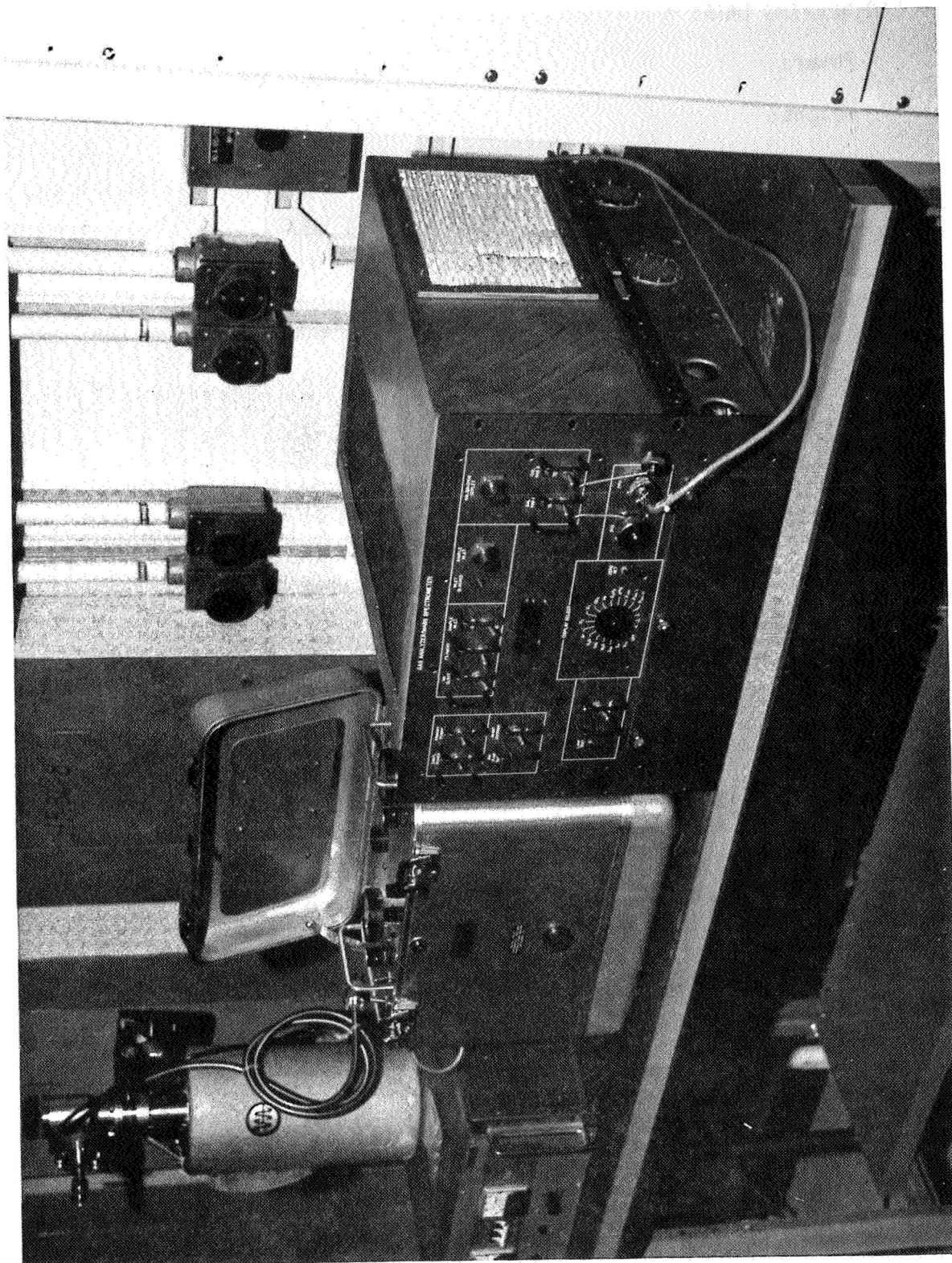
# ENGINEERING DATA:

Power: 28 VDC, 150 W.  
 Weight: 40.7 kg.  
 Size: 61.9 L x 42.8 W x 31.0 H cm.  
 Volume: 0.1 m3.  
 Panel units:\* 7

\*One (1) Panel Unit access must be located directly below the GAMS and will require vacuum connections.

## PROFILE PROFILE:





TITLE: PHYSIOLOGICAL MONITORING SYSTEM

STATUS: FABRICATION

CATALOG NUMBER: J008

DEVELOPMENT CENTER: JSC

PART NUMBER: JSC SED46102690-301

DESCRIPTION: The basic concept for the Physiological Monitoring System (PMS) is an on-body data interface system which will accept the input from various data detection sources and thence route this data to the appropriate onboard data display, recording, transmission interface, or manipulation devices. The PMS shall be able to handle up to eight separate channels of either digital or analog data in this way. The PMS shall also, in and of itself, have the capability to detect and accurately reproduce an ECG waveform and detect and accurately determine heart rate and arterial blood pressure. Each data channel input to the PMS shall have the capability to be output to the body-worn LSLE cassette data tape recorder, the Orbiter analog telemetry downlink interface or the LSLE microcomputer. The PMS shall have the capability of being self-powered (battery operated) or spacecraft powered. A digital display system, to provide correctly scaled digital displays of heart rate and blood pressure is available, remotely, on an umbilical from the main PMS module.

One very salient design consideration for the PMS shall be the capability to access virtually any combination of the data output systems for any given payload configuration. The PMS shall be operable as a totally self-contained body-worn system with data being recorded on the CDTR, with or without the remote digital display.

The main PMS module may be subdivided into two major segments. One of these segments, to be known as the Basic Parameters Module (BPM) will contain all equipment and systems necessary to obtain electrocardiogram (ECG), heart rate, Korotkoff sounds (K-sounds), and cuff pressure data, and condition same for interface into the Data Control Module (DCM). The DCM shall control and distribute the data from the BPM, plus up to five data channels from other sources and interface this data into the various display, recording, transmission interface, or computation/manipulation devices. Certain preprogrammed computational and scaling processes can be performed on the input data by the PMS prior to data transmission.

INVENTORY: Four Flight Units

ENGINEERING DATA:

Mass	2.1 kg
Dimension	10.5 x 6.5 x 3.13 cm
Power	Battery or Spacecraft 28 VDC 2 watts normally 5 watts additional during blood pressure cuff inflation, approximately 5 seconds per blood pressure measurement with a 30-45 second deflation cycle.

TITLE: BIOLOGICAL SPECIMEN TEST APPARATUS  
(BSTA)

STATUS: COMPLETE

CATALOG NUMBER: J009

DEVELOPMENT CENTER: JSC

PART NUMBER: GARLAND INT.103000

DESCRIPTION: This instrument provides 20x and 40x timelapse photomicrograph observations of cellular and tissue activity and/or provides chambers to maintain cellular and tissue specimens. A capability exists to add fixative or other solution to discrete chambers based on present program. The unit is entirely automatic with a required 28 VDC input.

The apparatus is a single self-contained unit which controls the power and maintains an ambient temperature of 37° C. Internally, the package is divided into a camera-microscope section and a separately sealed growth curve experiment section.

INVENTORY: Two Flight Units

TECHNICAL SPECIFICATION:

Enclosure:	Airtight with O-ring seal.
Number of chambers:	18.
Usable chamber area:	285 mm <sup>2</sup> .
Chamber depth:	1.8 mm.
Media volume:	0.5 ml.
Coverslip size:	25 mm diameter, 2 mm thick.
Thermal control:	Two redundant thermostats. One thermostat set for 309 ± 1.8 K (36° ± 1.8° C) and operative for days 1 to 12. One thermostat set for 295 ± 22 K (22° ± 2° C) and operative for days 12 to 59.

ENGINEERING DATA:

Size:	19.0 L x 39.4 W x 16.5 H cm.
Power:	28 VDC 16 W at 283 K (50° F). Ambient temperature
Weight:	10.0 9 kg.

Note: Qualification unit only

POWER PROFILE:

The power profile depends on user requirements. It varies with thermal control (see specification) with a maximum of 16 watts and a minimum of 3 watts.

## A black and white photograph of a vintage electronic device, likely a flight recorder or data logger. The device has a dark, rectangular metal casing. The front panel is densely packed with controls and labels. On the left, there are two large, white, cylindrical knobs. To their right are several smaller knobs and switches, some labeled "NORMAL", "TEST", "CAMERA", and "LAMP". A prominent label in the center reads "WOODLAND HANDMADE FLIGHT HANDWARE BYLAS EXPERIMENT ROOM DALLAS COUNTY HOSPITAL DISTRICT DALLAS TEXAS CONTACT RAG 9-210 REGD. NO.". To the right of this label is a large, white, U-shaped handle or lever. Below the handle is a small, rectangular label with the text "MONITORING". The device is shown from a slightly elevated, angled perspective, highlighting its three-dimensional form.



TITLE: ELECTROMYOGRAM SIGNAL CONDITIONER

STATUS: COMPLETE

CATALOG NUMBER: J011

DEVELOPMENT CENTER: JSC

PART NUMBER: DRI 139000

DESCRIPTION: The Electromyogram Signal Conditioner is a compact, lightweight, low power precision instrument especially designed to monitor an astronaut's heart or muscle potentials. The conditioner includes replaceable miniature silver oxide batteries and adjustable gain over a wide range.

INVENTORY: Sixteen Flight Units

#### TECHNICAL SPECIFICATIONS:

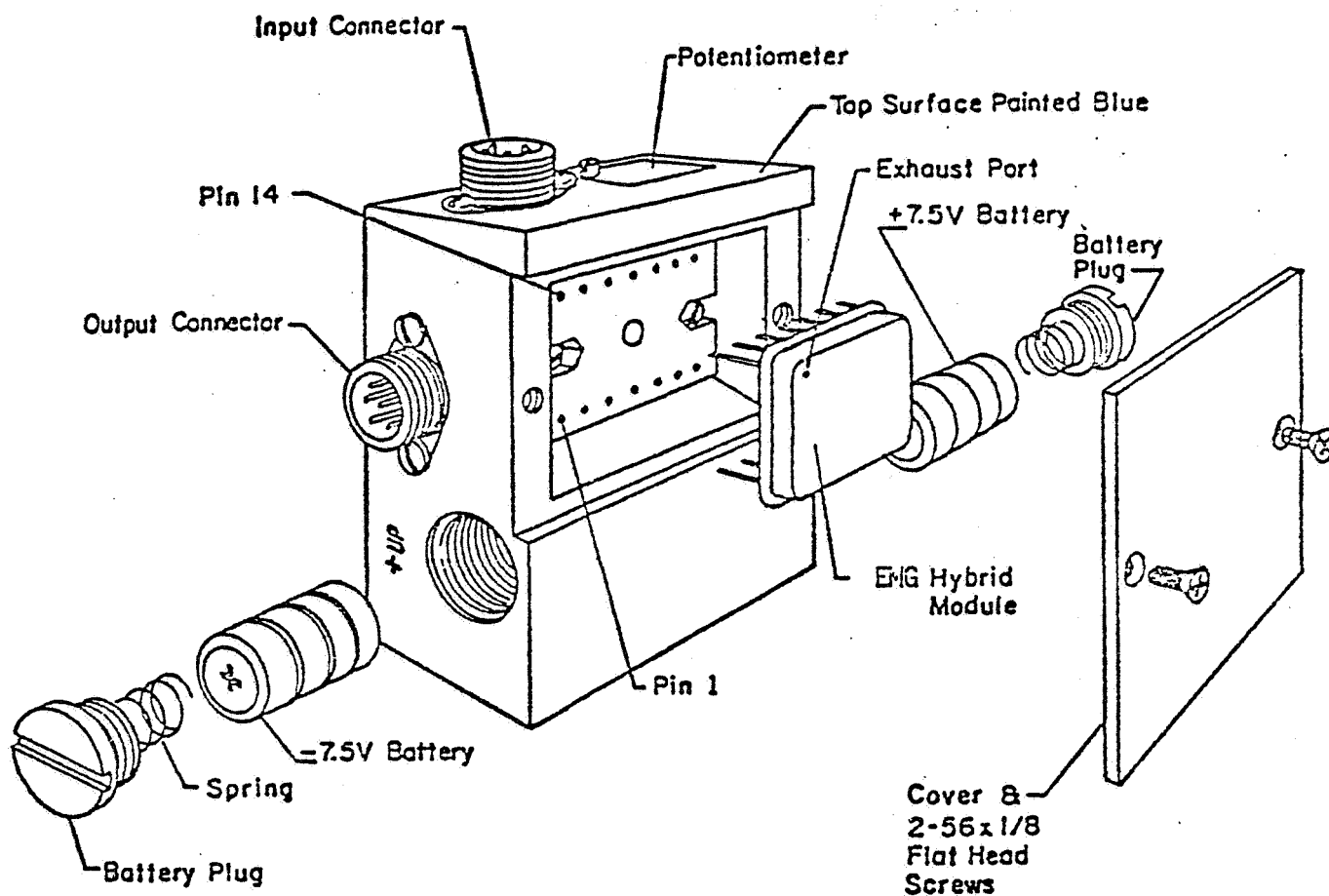
Frequency response:	50 to 350 Hz (-3dB $\pm$ 7dB).
Output DC offset:	0 $\pm$ 0.25 V.
Output noise:	<18.7 microvolts peak referred to input.
Output level:	>10 V peak maximum.
Gain:	<100 to 1000 adjustable.
Input impedance:	40 megohms minimum.
Allowable source impedance:	<1000K ohms.
Common mode rejection:	80 dB minimum.
Electro-shock protection:	All three inputs limited to 100 microamps for potential up to 200 V, DC to 2 kHz AC.
Recovery time:	<30 seconds for up to 1 V input transients.

#### ENGINEERING DATA:

Battery life:	Typically 400 hours continuous operation.
Dimensions (max)	1.6 D x 3.8 W x 4.7 H cm
Size:	21.5 cm <sup>3</sup> .
Weight:	55 gram complete with batteries.



# EMG Signal Conditioner



TITLE: POCKET VOICE RECORDER

STATUS: COMPLETE

CATALOG NUMBER: J013

DEVELOPMENT CENTER: JSC

PART NUMBER: JSC SED46100288-301

DESCRIPTION: The miniature, pocket type, battery powered voice recorder is the Olympus Pearlrecorder Model E420. This unit records for up to 2 hours on a single microcassette and will be used for voice recording during experiments.

INVENTORY: Eight Flight Units

TECHNICAL SPECIFICATIONS:

Track:

2 tracks, 1 channel,  
monophonic

Tape speeds:

2 speeds, 2.4 cm/sec and 1.2  
cm/sec.

Built-in speaker:

Frequency response:

300 to 5000 Hz at 2.4 cm/sec.  
400 to 4000 Hz at 1.2 cm/sec

ENGINEERING DATA:

Size:

2.8 L x 7.5 W x 12.5 H cm

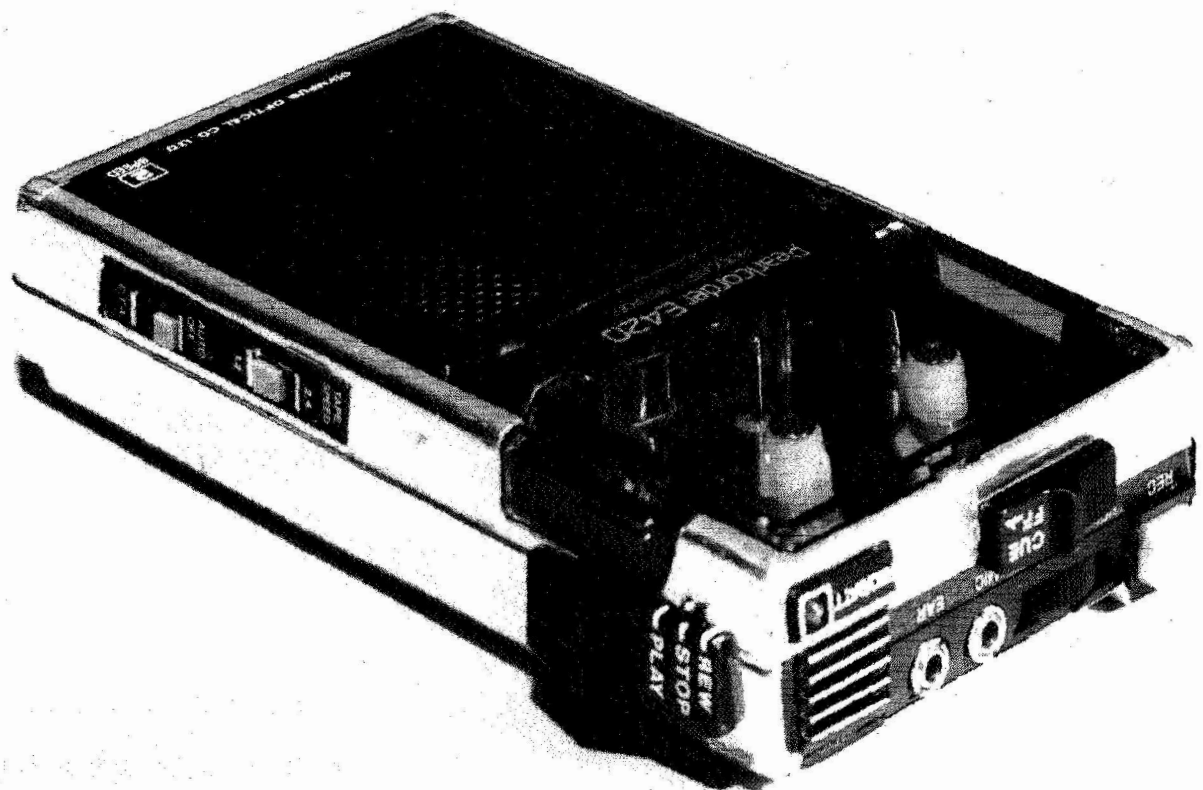
Weight:

0.26 kg with batteries.

Power Source

two 1.5V "AA" batteries

# Pocket Voice Recorder



TITLE: HEMATOCRIT CENTRIFUGE

STATUS: COMPLETE

CATALOG NUMBER: J016

DEVELOPMENT CENTER: JSC

PART NUMBER: JSC SDD42103003-401

DESCRIPTION: The hematocrit centrifuge is a lightweight device which requires 9 ul of blood for each of 6 capillaires, is handheld, and battery operated. The hematocrit determinations are read directly off the rotor after approximately 3 minutes of centrifugation. Small amounts of blood plasma can also be obtained. This centrifuge can be used to determine hematocrit during spaceflight.

INVENTORY: Three Flight Units

TECHNICAL SPECIFICATIONS:

Temp. range of operation:	0° to 40° C.
Stowage temp. range:	-20° to 55° C.
Speed of rotation:	11,500 rpm (5,396 g).
Duration of rotation:	3 min. 20 sec.
Accuracy:	<u>±</u> 1% full scale.
Range:	10% to 80%.
Microblood capillaries:	6 ea, 32mm in length. Heparinized. Volume is calibrated and approximately 9 ul.

ENGINEERING DATA:

Dimensions:	20 L x 8 W x 6 H cm.
Volume:	$9.60 \times 10^{-4} \text{ m}^3$ .
Weight:	with batteries - 0.83 kg. without batteries - 0.43 Kg.
Power:	6 manganese-alkali 1.5 V batteries

# Hematocrit Centrifuge



TITLE: BODY MASS MEASUREMENT DEVICE

STATUS: COMPLETE

CATALOG NUMBER: J017

DEVELOPMENT CENTER: JSC

PART NUMBER: SWRI 5618-001-01

DESCRIPTION: The function of the Body Mass Measurement Device (BMMD) is to measure in zero-g the mass of human subjects and other specimens or objects. Body mass determinations are made using a linear spring/mass pendulum platform or "seat". The mass being measured determines the period of the pendulum. The period is electronically timed and converted to mass readings.

The equipment consists of a seat, a spring-loaded pendulum system, a supporting frame, timing electronics and sensors, specimen restraint, and a control and display system.

INVENTORY: Two Flight Units

#### TECHNICAL SPECIFICATION

Measuring Capacity:

10 kg to 100 kg

\*Accuracy

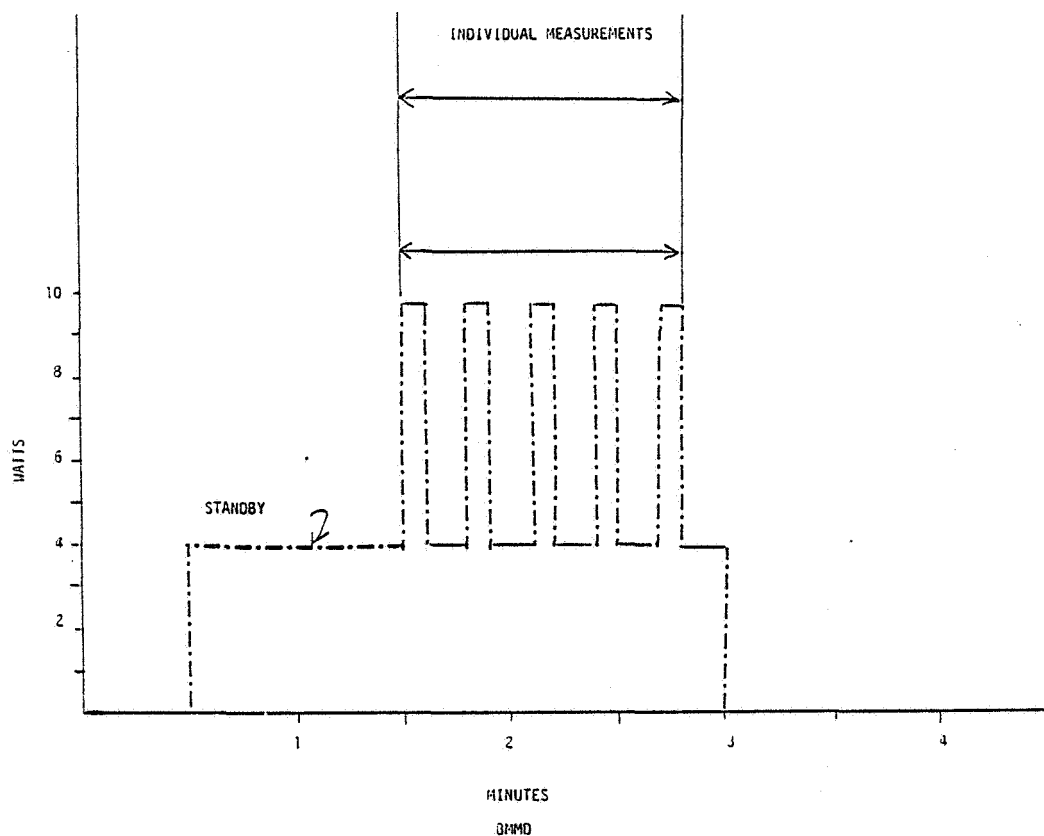
± 25 g.

# ENGINEERING DATA:

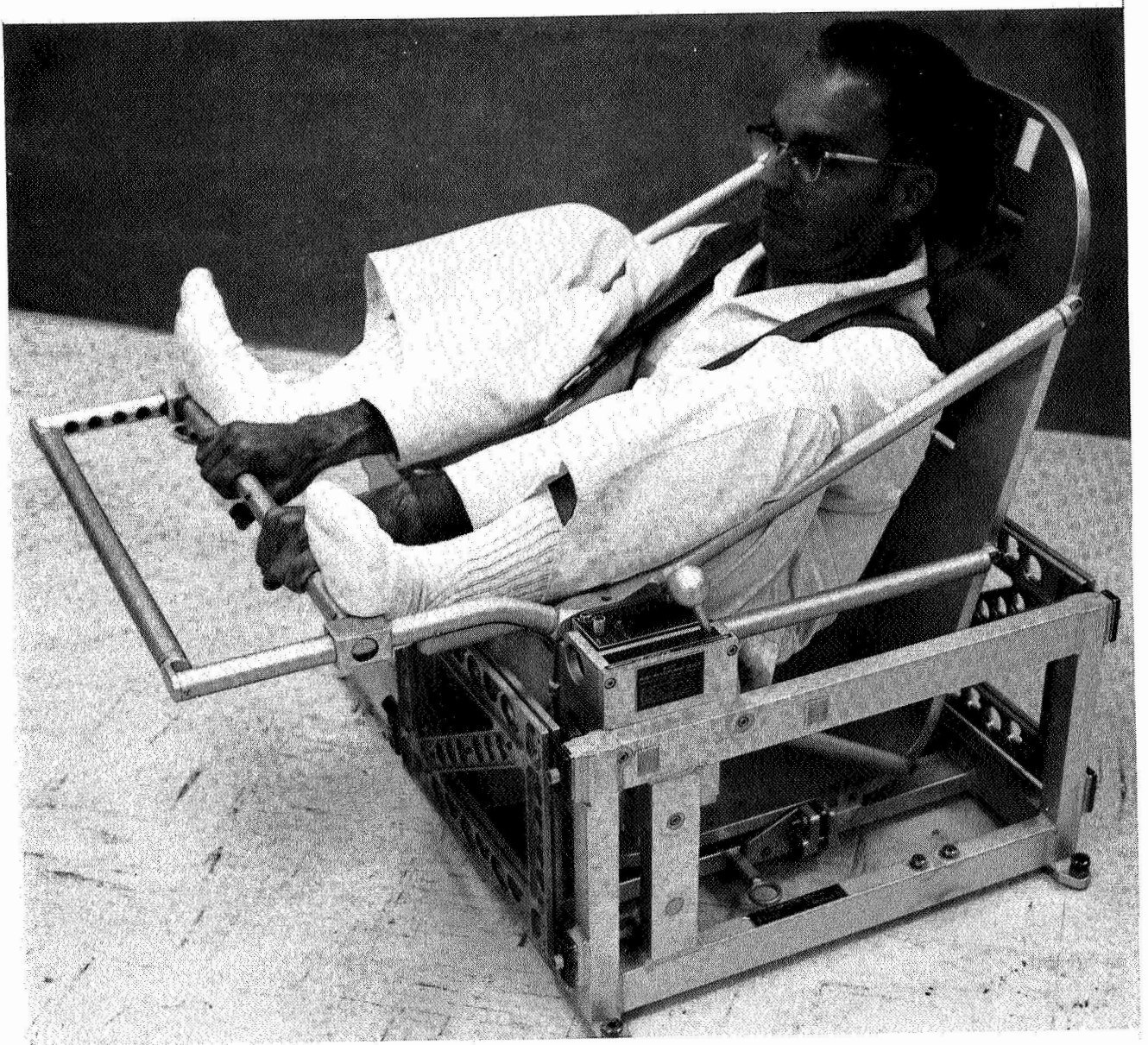
Dimensions: 96.5 L x 77.5 W x 79.4 H cm.  
Weight: 38.5 kg.  
Power: 15 W/28 V DC.  
Volume: 0.60 m<sup>3</sup>.

\*Accuracy base on minimum of 95% of subjects with weights ranging from 59 to 95.5 kg.

## POWER PROFILE:



/ Body Mass Measurement Device





TITLE: MULTICHANNEL STRIP CHART RECORDER

STATUS: FABRICATION

CATALOG NUMBER: J018

DEVELOPMENT CENTER: JSC

PART NUMBER: JSC SED46102083-301

DESCRIPTION: The multichannel strip chart recorder (MSCR) is a variable speed thermal recorder used to obtain a permanent graphic record of experiment data that can be used to verify experiment equipment operation or for later evaluation of experiment data. A chart paper takeup and storage mechanism will be part of the MSCR. The unit is rack mounted and protrudes 12" or more for operation. Possible parameters to be monitored are:

INVENTORY: Two Flight Units

#### Cardiovascular

- o ECG
- o Heart sounds
- o Direct blood pressure - arterial venous
- o Blood flow
- o Blood chemistry
- o Temperature, body or skin
- o Echocardiograph

#### Neurophysiology

- o Electroencephalogram (EEG)
- o Electromyogram (EMG)
- o Basal skin response (BSR)
- o Galvanic skin response (GSR)
- o Electro-oculogram (EOG)
- o Electroretinogram (ERG)

#### Respiratory

- o Respiration rate
- o Lung volumes
- o Respiratory gas analysis

#### Mechanical

- o Air or surface temperature
- o Air or liquid flow rates
- o Pressures and pressure differentials

# TECHNICAL SPECIFICATION:

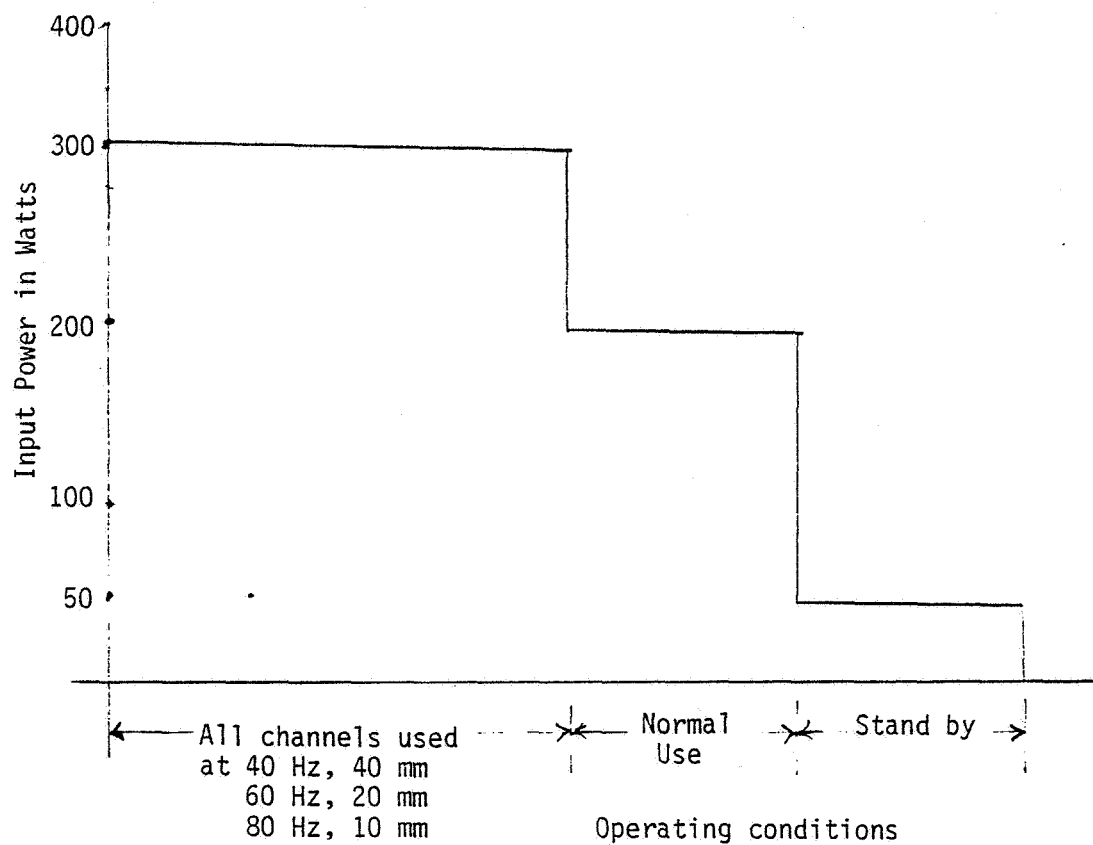
Speed selector range:	5, 10, 25, 50, 100, 250, and 500 mm/sec and mm/min., and EXT 50 mm/sec max.
Event marker:	Yes.
Time marker:	Yes.
No. of channels:	6
Frequency response:	0 to 55 Hz      40 mm amplitude 0 to 80 Hz      20 mm amplitude 0 to 120 Hz     10 mm amplitude
Preamps ranges:	5, 10, 20, 50, 100, 200, 500, 1000 mv/cm 0.5, 1, 2, 5, 10, 20, 50, 100 v/cm
Remote control operation:	All TTL compatible paper advance by pulse string up to 50 mm/sec continuos. Time marking by timing pulses Event marking by event signals Heat ON/OFF control Chart start/stop control
Printout:	Data; time (period of time); data number, speed of recording paper advance; "centronics" which prints the desired numbers, symbols, in the ASCII and Kana* codes input from external equipment.

\*Kana is a Japanese Code

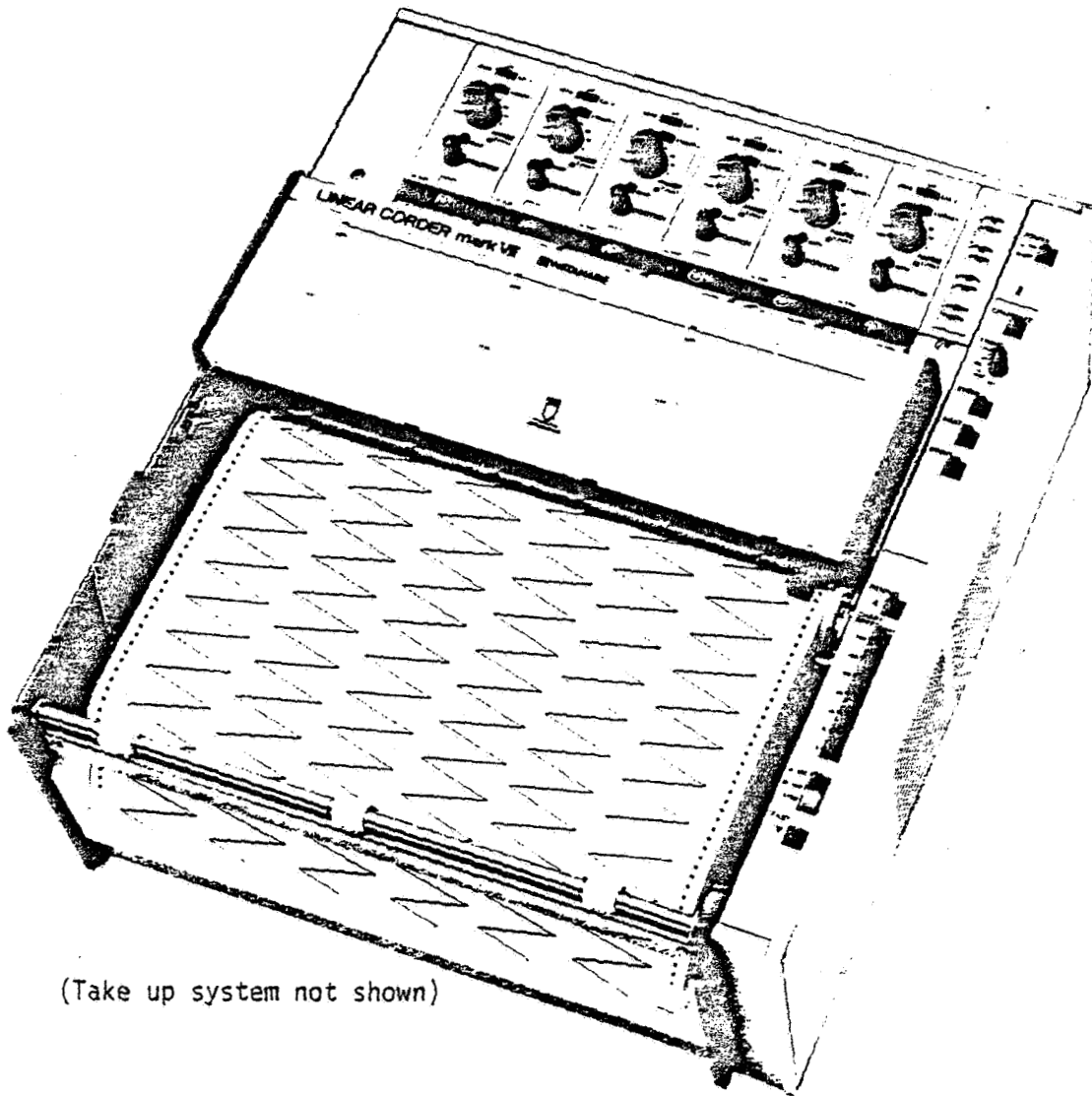
ENGINEERING DATA: (includes take up system)

Volume:	$<0.04 \text{ m}^3$
Dimensions	W 37.9 x H 18.5 x D 58.4 cm. (with paper take up system)
Mass:	24 kg. Approx.
Power:	360 watts (Max), 200 watts avg.
Panel Unit:	6

POWER PROFILE:



# Multichannel Strip Chart Recorder



(Take up system not shown)

TITLE: ORBITER CENTRIFUGE

STATUS: COMPLETED

CATALOG NUMBER: J019

DEVELOPMENT CENTER: JSC

PART NUMBER: 000-1065-000

DESCRIPTION: The function of the laboratory centrifuge is to perform separations inherent in blood-related Life Sciences research. The centrifuge shall provide a minimum relative centrifugal force of 1400-times gravity when fully loaded. There will be an automatic shutdown time that may be manually set for operating durations selectable up to 99 minutes in increments of 1 minute. An override will be available so that manual starting and stopping can be initiated without intervention by the timer. The Centrifuge is mounted by two suction cups.

INVENTORY: Two Flight Units

#### TECHNICAL SPECIFICATIONS:

Tube capacity:

Head can be modified to accommodate different specimens.

Containers

Nominal value:

15 ml.

Outside diameter:

17 mm.

Length:

133 mm.

No. of tubes:

12.

Fully loaded centrifugal force:

1400 x g (min)  
speed not variable.

Timer:

Variable in 1 minute  
increments up to 99  
minutes.

ENGINEERING DATA:

Dimensions:	49 L x 41 W x 23 H cm.
Weight:	11.36 kg.
Volume:	$4.62 \times 10^{-2} \text{ m}^3$ .
Input power:	115/200 V, 3 phase/4 wire 400 Hz, 1.33 amps (full load). Power cable mates with utility outlet stowed in standard mid-deck locker.

POWER PROFILE: TBD

# Orbiter Centrifuge



TITLE: GN<sub>2</sub> PASSIVE FREEZER

STATUS: COMPLETE

CATALOG NUMBER: J022

DEVELOPMENT CENTER: JSC

PART NUMBER: SD-404-P

DESCRIPTION: The GN<sub>2</sub> passive freezer will be employed to freeze experiment samples and blood samples and to keep them frozen until landing and recovery. It is a passive freezer employing GN<sub>2</sub> as the cryogen.

The passive freezer consists of two flasks (one contained within the other). The space between the flasks is evacuated for thermal insulation. The inner flask contains calcium silicate which is employed to absorb the LN<sub>2</sub>, hold it, and release GN<sub>2</sub> as heat is absorbed from the specimens and surroundings. At the center of the calcium silicate is a cylinder which holds the specimens.

Features of GN<sub>2</sub> passive freezer include:

- o Stored in standard locker compartments in Orbiter middeck.
- o Requires no crew attention except insertion of specimens
- o Designed to permit opening about ten times per flight (for specimen insertion and removal).

INVENTORY: Fourteen Flight Units

#### TECHNICAL SPECIFICATIONS:

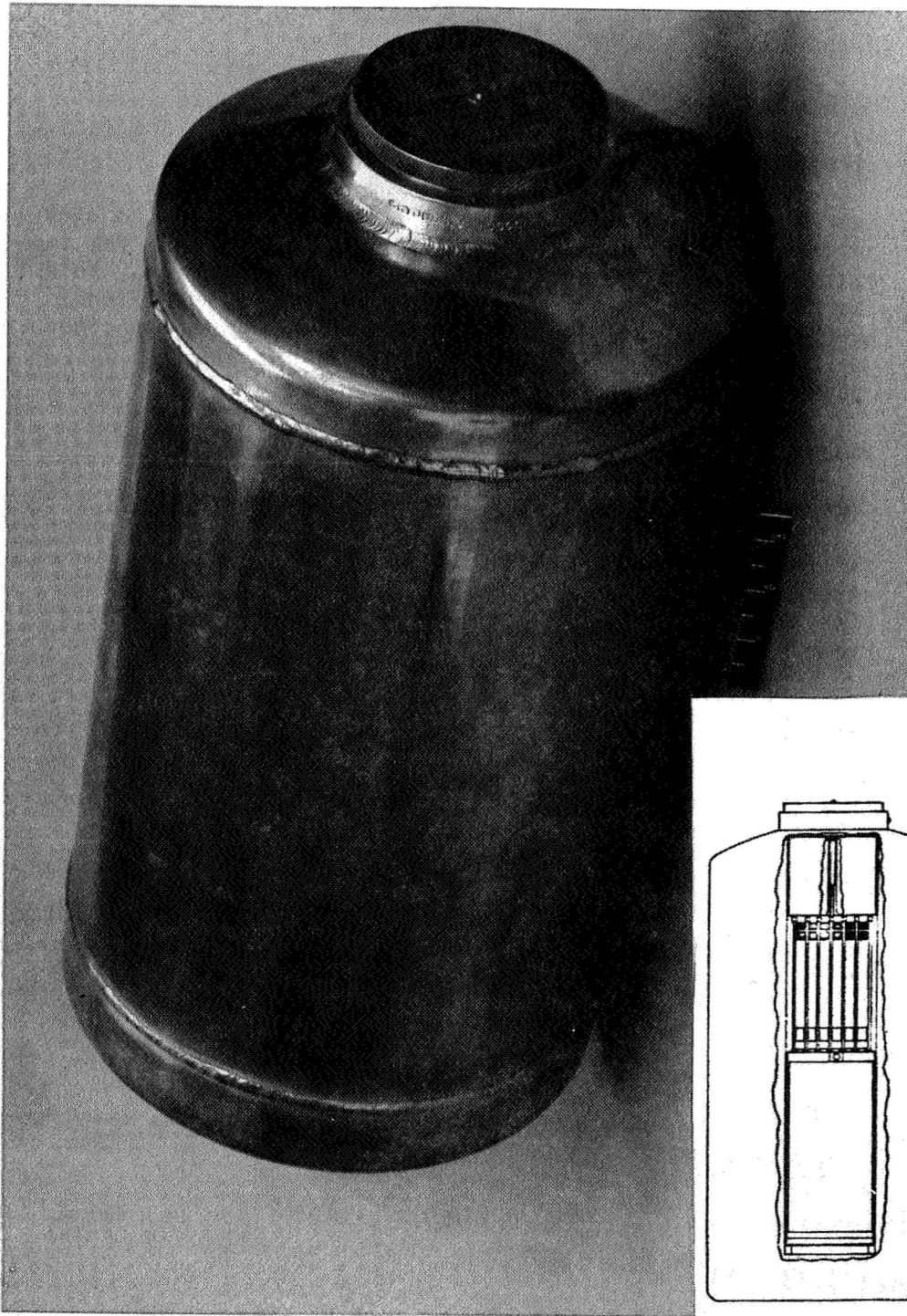
Temperature:	-195° C to -185° C.
Capacity:	
Inside diameter:	8.9 cm.
Length:	34 cm
Holding time:	8 days minimum.

#### ENGINEERING DATA:

Power:	None.
Weight:	13.5 kg/unit (charged).
Dimension (external):	50.8 L x 24.1 W x 24.1 H cm.
External volume:	$2.32 \times 10^{-2} \text{ m}^3$ .
Internal volume:	$2.1 \times 10^{-3} \text{ m}^3$ .



# $\text{GN}_2$ Passive Freezer



TITLE: ULTRASOUND LIMB PLETHYSMOGRAPH

STATUS: COMPLETE

CATALOG NUMBER: J023

DEVELOPMENT CENTER: JSC

PART NUMBER: 15416

DESCRIPTION: The ultrasound limb plethysmograph provides a means for measuring and recording limb volume changes during exposure to physiological stresses in a zero-g or one-g environment. This limb plethysmograph measures limb changes based on the measurement of transit times for ultrasonic pulses to propagate from one point on the limb to another. All the electronics are housed in a single unit except for the transducer crystals located on the subject. It will be battery powered for use during launch and re-entry.

INVENTORY: Four Flight Units

TECHNICAL SPECIFICATION:

Accuracy:

Recording time:

15 hrs. in 2-transmitter mode  
7.5 hrs. in 4-transmitter mode

Range:

10% to +10% of limb volume  
change.

ENGINEERING DATA:

Weight:

1.5 kg.

Power:

Battery.

Volume:

$1.36 \times 10^{-3} \text{ m}^3$ .

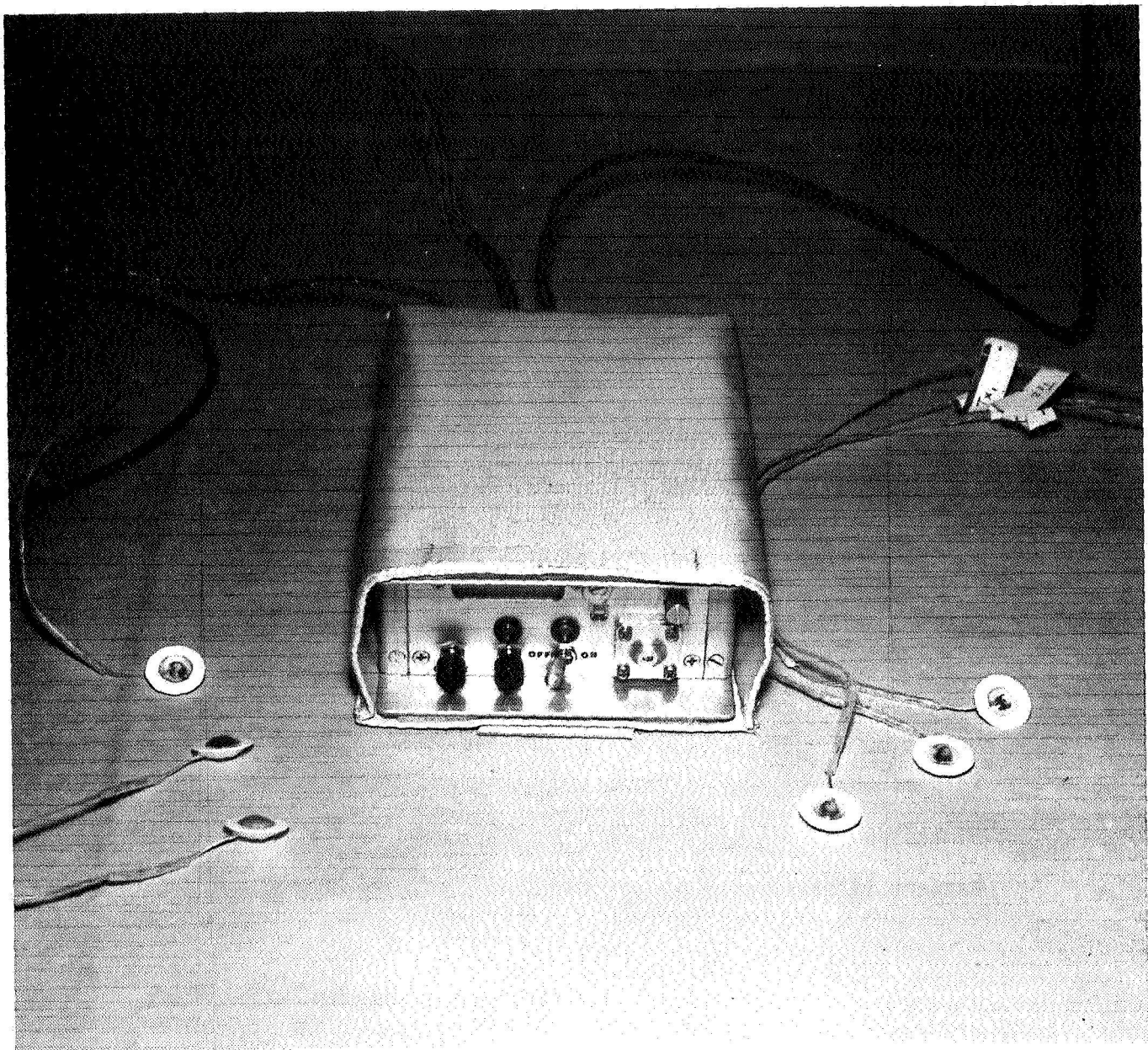
Dimension:

18.9 L x 12.0 W x 6.0 H cm.

Battery life:

30 hrs.

# Ultrasonic Plethysmograph System Components



TITLE: BICYCLE ERGOMETER

STATUS: Fabrication

CATALOG NUMBER: J024

DEVELOPMENT CENTER: JSC

PART NUMBER: JSC SED46100581-301

DESCRIPTION: The bicycle ergometer provides a quantitative measure of the exercise stress induced in a subject for experiments that evaluate the effects of zero-g on the cardiovascular system. The equipment consists of a variable work load, driven by hands or feet, that is controlled by the subject's heart rate, manual adjustment, or computer control. It will operate in the one-g environment with the subject seated or supine.

INVENTORY: Two Flight Units

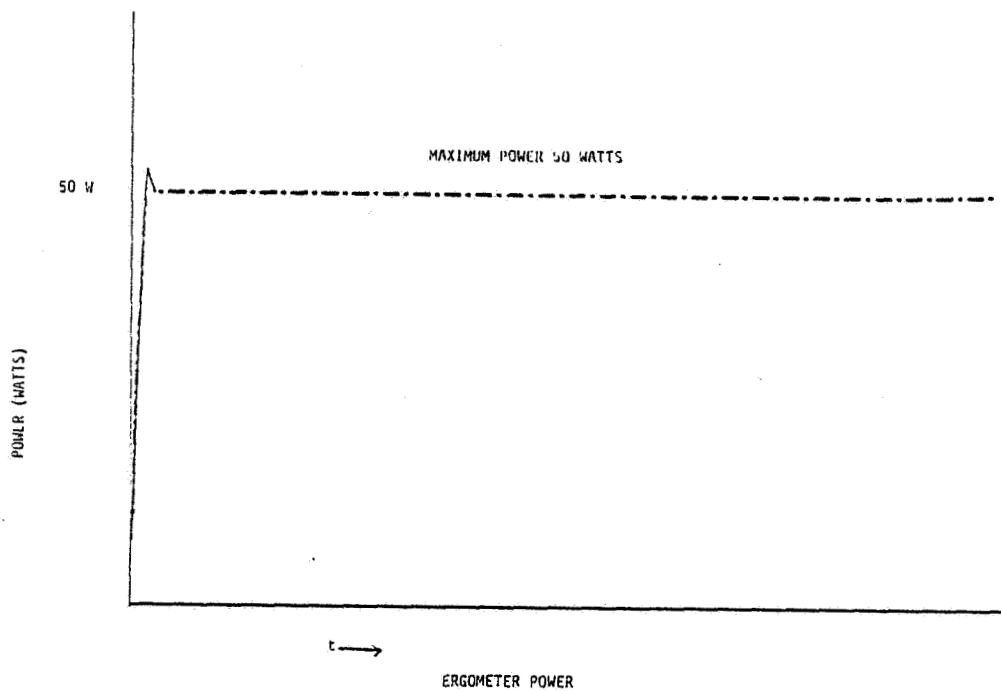
#### TECHNICAL SPECIFICATIONS:

Work load:	10 to 350 W $\pm$ 5 W.
Pedal speed:	40 to 80 rpm.
Heart rate Control range:	40 to 200 beats per minute.
Displays:	Watt load, heart rate, total work
Inputs:	Workload 0-10 VDC High Level ECG (1 volt min.)
Outputs:	Workload 0-10 VDC RPM 0-10 VDC Heart Rate 0-10 VDC

ENGINEERING DATA:

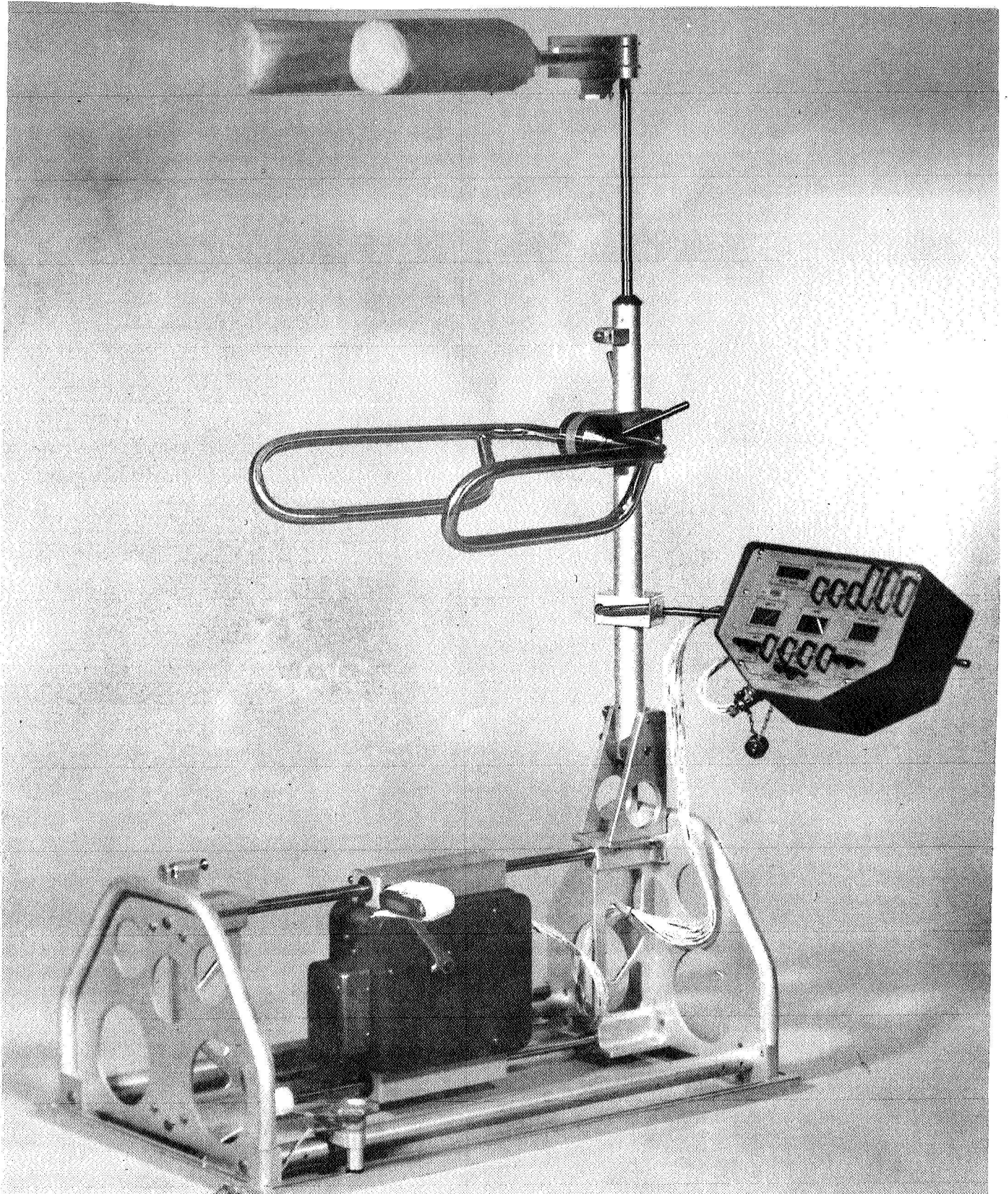
Weight:	70 kg.
Power:	50 W, 28 VDC.
Volume:	0.40 m <sup>3</sup> .
Dimensions:	108.7 L x 61 W x 58.4 H cm Launch/Landing

POWER PROFILE:





## Bicycle Ergometer



TITLE: URINE MONITORING SYSTEM

STATUS: COMPLETE

CATALOG NUMBER: J027

DEVELOPMENT CENTER: JSC

PART NUMBER: GE 47E231850G2

DESCRIPTION: The Urine Monitoring System (UMS) provides for the collection, volume measurement, and sampling of individual micturitions in either zero gravity or normal gravity environment. Measurement of the total quantity of urine voided by each subject shall be automatically measured in real time. A urine sample from each micturition can be collected and preserved with a NASA specified chemical additive. An automatic water flush capability for reducing chemical cross-contamination will be provided which reduces cross-contamination from sample to sample to 0.5 ml (or less).

Excess urine shall be automatically transported to the Shuttle orbiter waste collection system for disposal in the spacecraft waste liquid storage tanks. The urinal assembly utilizes pneumatic tubes to transport urine and direct it into the phase separator which removes the transport air and filters out large particles. The urinal assembly is capable of accommodating both male and female users in a standup or seated position.

INVENTORY: Two Flight Units

#### TECHNICAL SPECIFICATIONS:

##### Collection:

The system will have the capability to handle the following urine input volumes and flow rates.

Maximum urine delivery rate of 25 ml/sec.

Maximum single micturition of 1000 ml.

Minimum single void of 35 ml\*.

\* The system will have the capability of handling less than a 35 ml void but not without sacrificing the volume measurement accuracy of +2%.

Sampling capability:

Sample size is 20 ml (option to obtain multiple samples for a given void).

Sampling is optional.

Optional urine preservation by chemicals or freezing (if freezer is available).

Each volume measurement is user identifiable.

Sample containers are sterilizable, do not degrade sample, and are resealable after use.

Cross-contamination is less than 0.5 ml from sample to sample.



## ENGINEERING DATA:

### Size:

Main assembly:	43.18 L x 30.48 W x 22.86 H cm.
Hose (urinal):	107 L x 3.81 D cm.
Urinal assembly:	12.7 L x 5.5 W x 10.1 H cm.
Hose (flush):	107 L x 0.63 D cm.
Hose (WCS):	89 L x 3.81 D cm.
Water hose assembly G2:	25.4 L x 0.63 D cm.
Water hose assembly G3:	127 L x 0.63 D cm.
Microbiol. check valve:	12.7 L x 5.1 D cm.

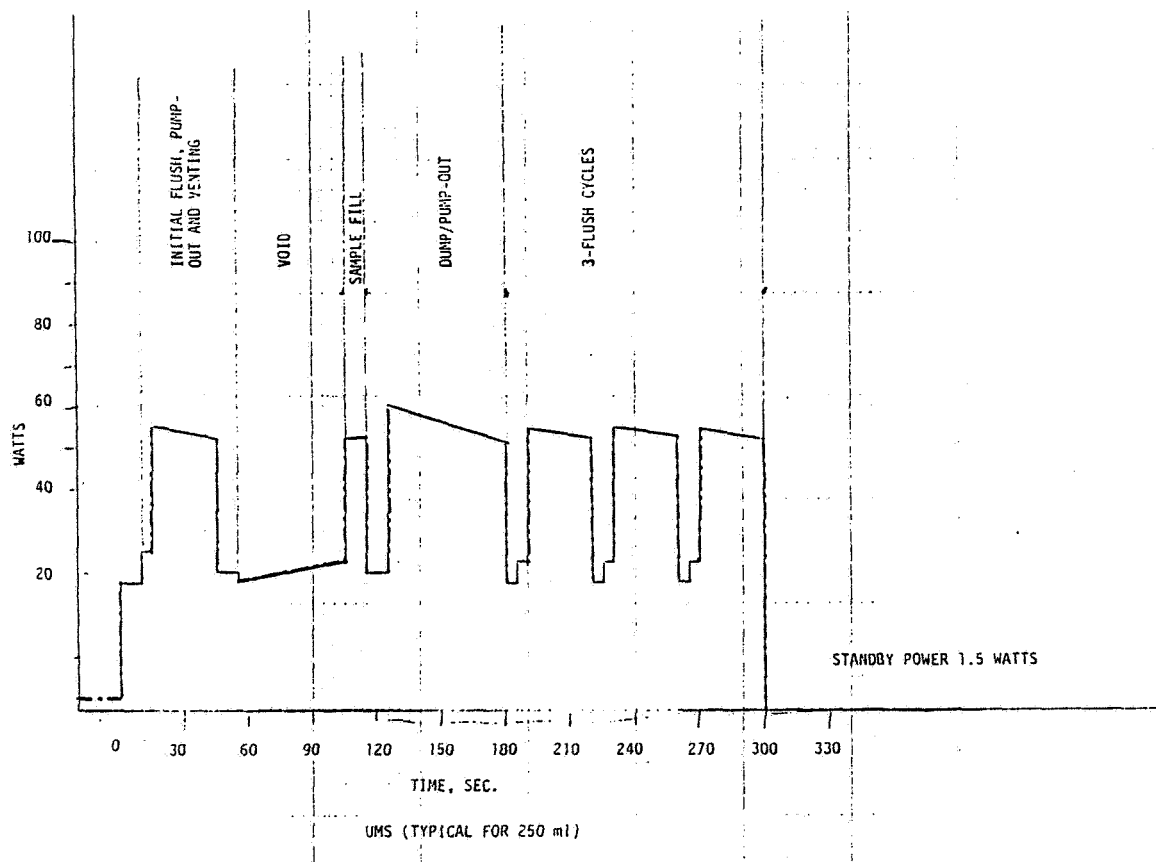
### Weight:

21.7 kg.

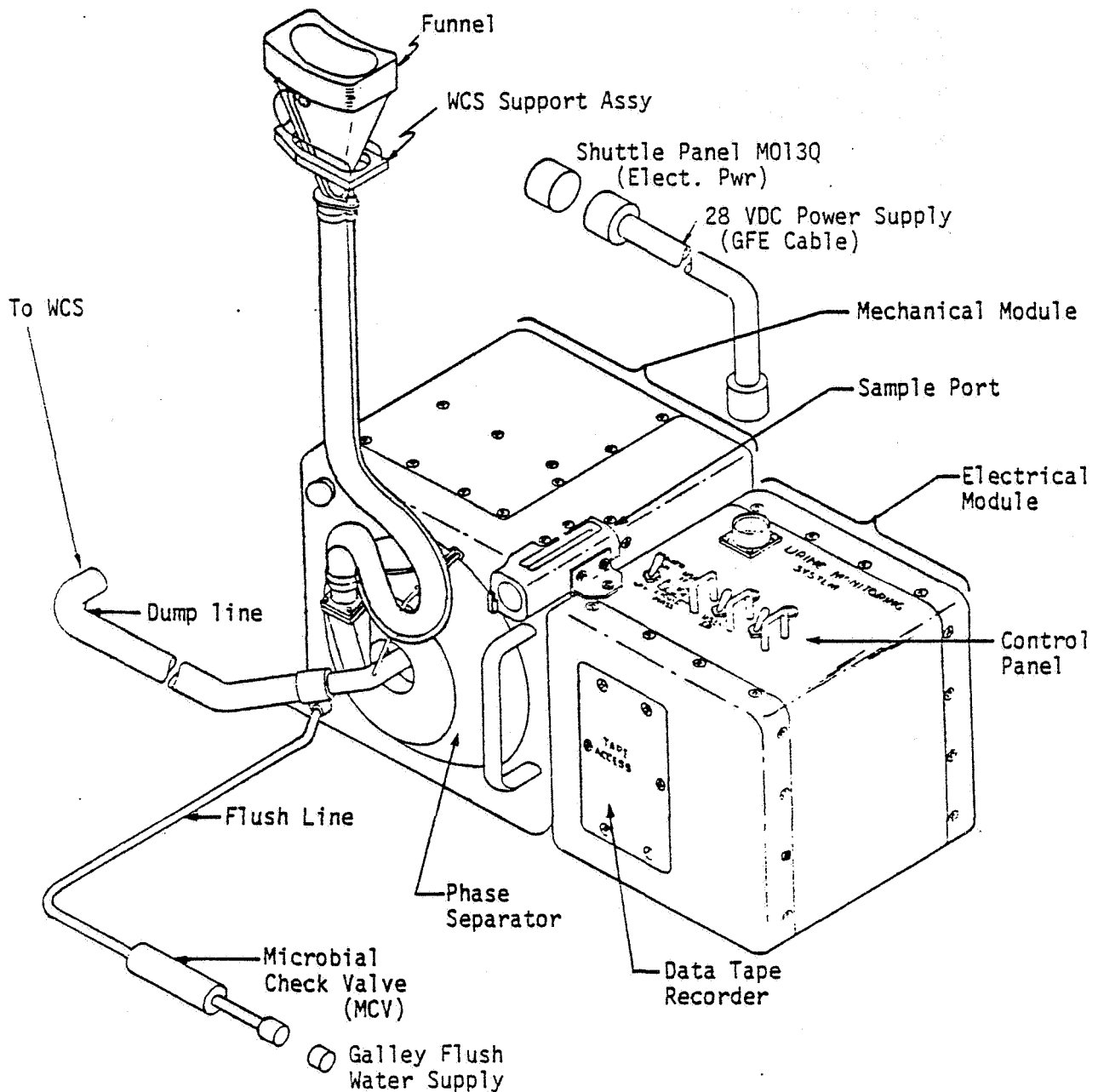
### Power:

28 VDC, 85 W peak, 50 W average,  
1.5 W standby.

## POWER PROFILE:



# Urine Monitoring System



TITLE: VENOUS OCCLUSION CUFF

STATUS: FABRICATION

CATALOG NUMBER: J029

DEVELOPMENT CENTER: JSC

PART NUMBER: VOCC-30-0000

DESCRIPTION: In order to induce a physiological stress on the measured limb, an inflatable venous occlusion cuff will be used. This cuff is electronically controlled. Parameters such as time between inflations, upper inflation pressure can be controlled. Safety features include: manual start and abort, automatic abort above 300 mmHg, after three seconds of pumping, and during power loss. The pressure source for the cuff is a battery powered air pump. The cuff is made to fit the thigh and upper arm. This cuff produces parallel digital data for downlink capability and local display.

INVENTORY: Two Flight Units

TECHNICAL SPECIFICATIONS (Cuff Controller):

Programmable pressure range:	5-255 mmHg.
Pressure levels:	5-50 mm (arm) 5-90 mm (leg)
Inflation rate:	>75 mmHg/sec.
Command to next level:	Manual
Pressure accuracy:	<u>+3</u> mmHg.
Pressure repeatability	<u>±</u> 2 mmHg.
Pressure profile:	Manual command and pre-programmed
Motor cutoff time:	3.0 seconds.
Automatic deflation time:	90 seconds.
Inflation cycles per charge:	>100 cycles to 160 mmHg.
Hold time to any level:	Variable up to 5 minutes maximum
Cuff deflation:	less than 5 seconds to 5 mmHg.

ENGINEERING DATA (Overall):

Power:

Battery - 6 VDC

Weight:

2.6 kg.

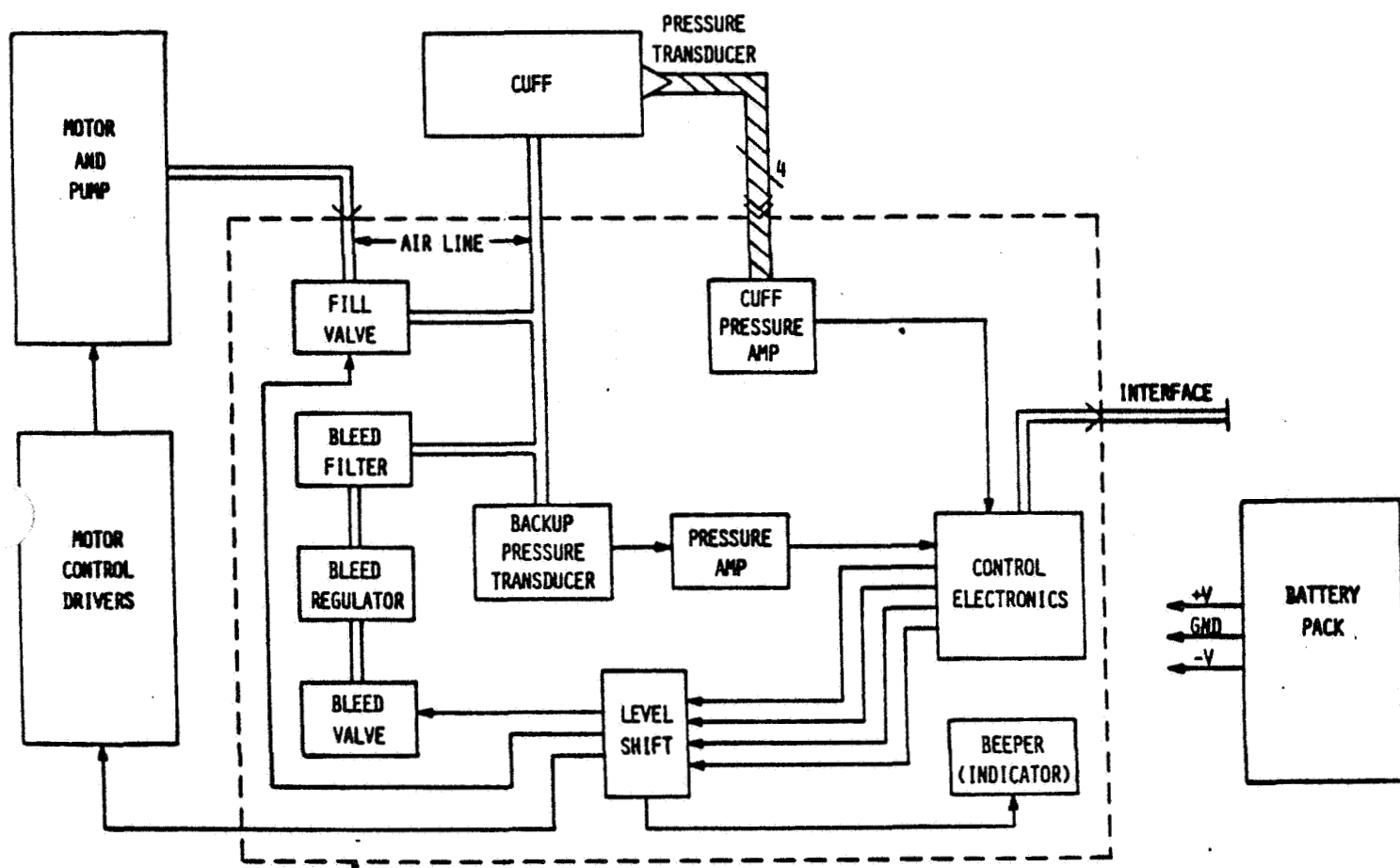
Dimensions:

24.0 L x 13 W x 6.4 H cm

Volume:

$2.0 \times 10^{-3} \text{ m}^3$

### Venous Occlusion Cuff



TITLE: ELECTRODE IMPEDANCE METER

STATUS: COMPLETE

CATALOG NUMBER: J032

DEVELOPMENT CENTER: JSC

PART NUMBER: UF1-1089-SPI

DESCRIPTION: The Electrode Impedance Meter will be used to measure the impedance of up to 12 recording electrodes via a multi-pin electrode connector. The impedance of the electrode under test will be determined with respect to all other electrodes shorted together. Electrode impedance will be displayed digitally on a 3-1/2 digit liquid crystal display (LCD). This portable meter will be stowed in a Spacelab stowage container.

INVENTORY: Five Flight Units

#### TECHNICAL SPECIFICATIONS:

Range:	0 to 1 megohm.
Display:	3-1/2 digit LCD.
Resolution:	1 kilohm.
Accuracy:	+5% of actual reading, except In the range of 0 to 20 kilohms where the accuracy will be <u>+1</u> kilohm.
Maximum out put current:	10 microamperes rms (to electrodes).
Internal oscillator:	Pulse, 30 Hz <u>+5</u> %.

#### ENGINEERING DATA:

Size:	15.6 L x 10.5 W x 5.35 H cm.
Weight:	0.6 kg.
Volume:	876.33 cm <sup>3</sup> .
Power:	battery, 110 mV average.

# Electrode Impedance Meter



TITLE: LOWER BODY NEGATIVE  
PRESSURE DEVICE

STATUS: FABRICATION

CATALOG NUMBER: J033

DEVELOPMENT CENTER: JSC

PART NUMBER: 10901-10001-01

DESCRIPTION: The Lower Body Negative Pressure Device (LBNPD) is a cylinder that encloses the lower abdomen and extremities of a human to maintain a controlled pressure differential below ambient during periods of extended weightlessness.

INVENTORY: Two Flight Units

ENGINEERING DATA:

Stowed dimensions:

55.8 Dia. x 50 cm.

Mass:

19.2 kg.

Pressure differential:

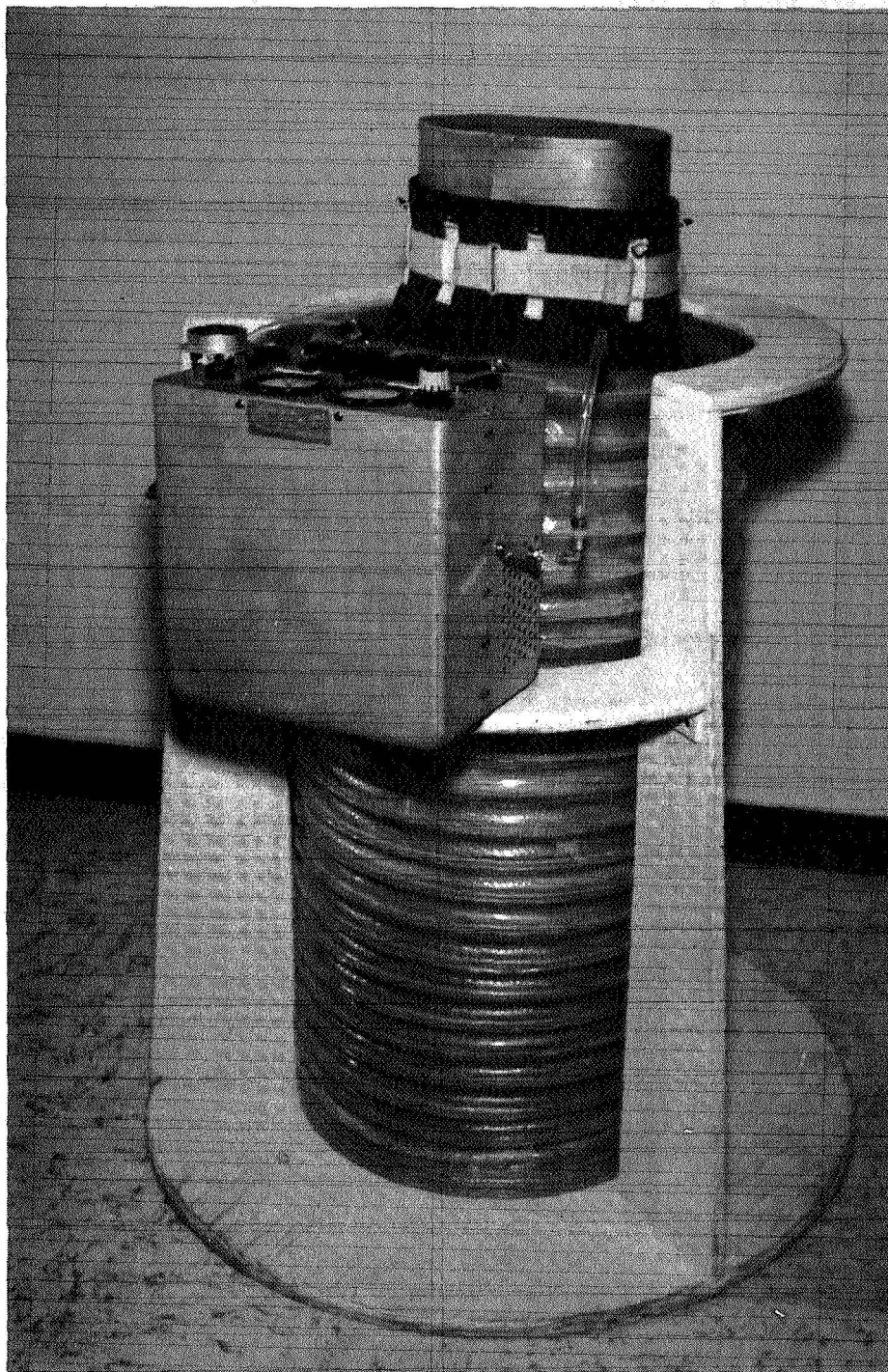
0 to -60 mmHg (referenced to ambient)

Power:

48 W, 28 VDC.



# Lower Body Negative Pressure Device



TITLE: STOWAGE CONTAINER - 001

STATUS: COMPLETE

CATALOG NUMBER: J037

DEVELOPMENT CENTER: JSC

PART NUMBER: SED46100194-302

DESCRIPTION: The 001 stowage container is a general purpose locker which will be installed in the upper portion of a standard Spacelab rack. The unit is flush mounted. The 001 stowage container is hinged on the bottom horizontal edge and across the middle. The door folds down horizontally. It may also be mounted in the rack so that the container is hinged on the top horizontal edge with the door folding up.

INVENTORY: Three Flight Units

ENGINEERING DATA:

Weight:

5.2 kg (11.5 lb).

Clearance (outside):

52.6 cm (20.7 in.) in length.  
48.3 cm (19.0 in.) in width.  
39.9 cm (15.7 in.) in height.

Clearance (inside):

38.1 cm (15.00 in.) in length.  
41.17 cm (16.21 in.) in width.  
34.67 cm (13.65 in.) in height.

TITLE: STOWAGE CONTAINER - 002

STATUS: COMPLETE

CATALOG NUMBER: J038

DEVELOPMENT CENTER: JSC

PART NUMBERS: SED46100167-302  
SED46100700-301

DESCRIPTION: The 002 stowage container is a general purpose locker which will be installed in the lower portion of a standard Spacelab rack. The unit is flush mounted. The door operates by a thumb-finger squeeze latch for one handed opening. The stowage container can be configured to allow the door to open to the left or right.

INVENTORY: SED46100167-302 - 3 Flight Units  
SED46100700-301 - 1 Flight Unit

ENGINEERING DATA:

Weight: SED46100167-302  
SED46100700-301

6.8 kg ea. (15 lb)  
9. kg ea. (19.9 lb)

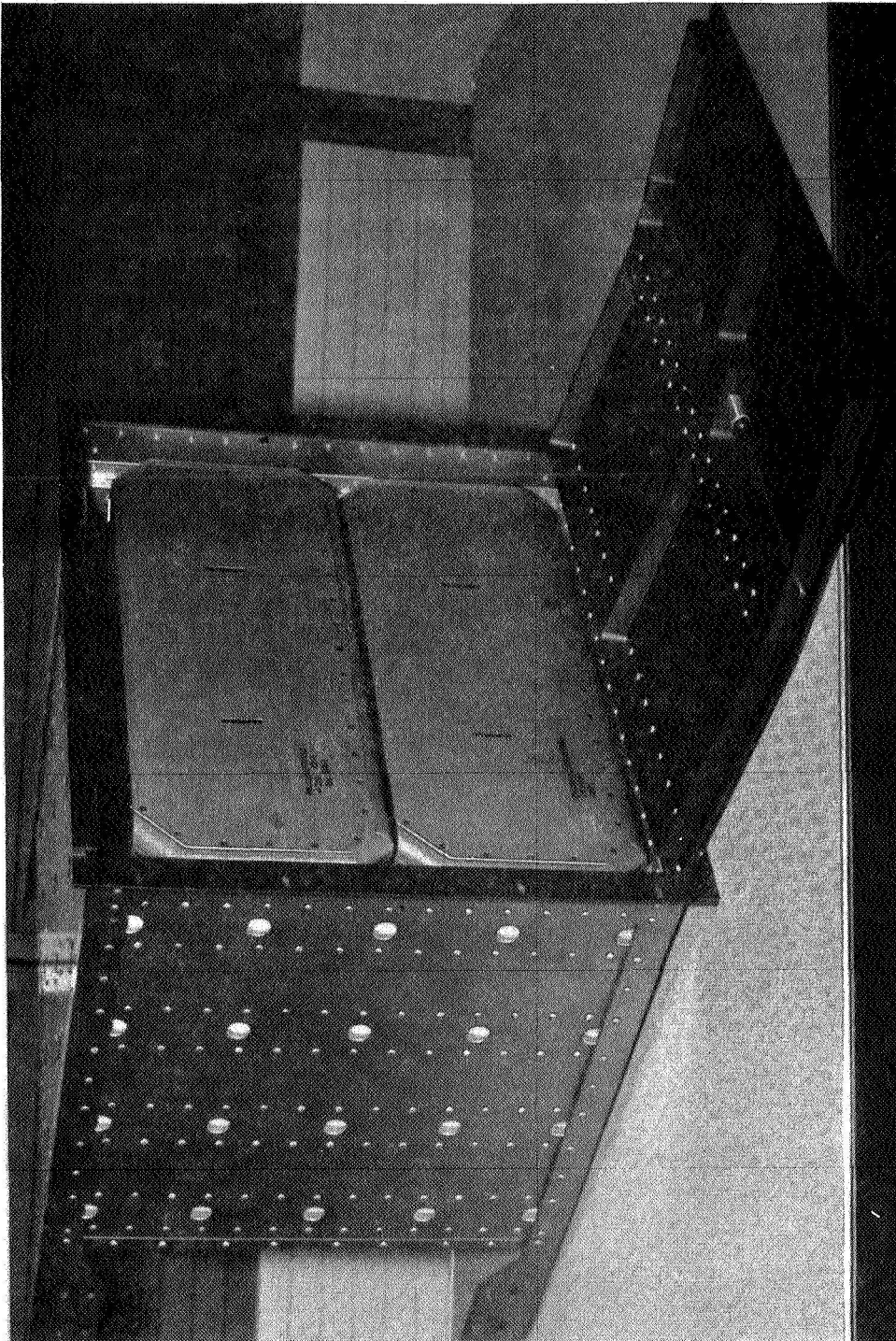
Clearance (outside):

72.86 cm (28.72 in.) including  
door in length.  
48.26 cm (19.00 in.) in width.  
53.24 cm (20.96 in.) in  
height.

Clearance (inside):

58.75 cm (23.13 in.) in  
length.  
41.17 cm (16.21 in.) width  
48.03 cm (18.91 in) height

## Stowage Containers



TITLE: SL-2 INFLIGHT BLOOD COLLECTION SYSTEM

STATUS: FABRICATION

CATALOG NUMBER: J041

DEVELOPMENT CENTER: JSC

PART NUMBER: N/A

DESCRIPTION: The SL-2 Inflight Blood Collection System (IBCS) is a simpler version of the SL-1 IBCS and is stowed in the Orbiter middeck instead of stowed in the Spacelab. It contains 15 ml Corvac tubes, surgical tape, a tourniquet, cotton balls, alcohol wipes, luer adapters, a vacutainer holder, and infusion sets. These items are contained in two identical foam trays, one for mission day 2 and one for mission day 6.

INVENTORY: Two Flight Units

ENGINEERING DATA:

Power:

None.

Volume:

0.050 m<sup>3</sup>.

Mass:

2 kg (estimate).

Dimensions:

58.42 L x 41.91 W x 20.32 Hcm.

TITLE: LOW-GRAVITY CENTRIFUGE

STATUS: FABRICATION

CATALOG NUMBER: J043

DEVELOPMENT CENTER: JSC

PART NUMBER: 000-0011-001

DESCRIPTION: The low "g" centrifuge will be used for low "g" separation processes and also to maintain certain specimens at low "g" states for relatively prolonged periods, as required by various Life Science investigations, during Earth orbital flight aboard the Spacelab module of the Space Transportation System.

INVENTORY: Three Flight Units

TECHNICAL SPECIFICATIONS:

1. G-range 0.5, 1.0, 1.5, and 2.0xg
2. Accuracy - +5% of the set point
3. Temperature -  $37 \pm 0.5^{\circ}\text{C}$
4. Provide for sensing temperature continuously
5. Provide for monitoring speed

ENGINEERING DATA:

DIMENSIONS:	12.2 x 19.0 x 21.0
Weight:	35 lbs. (max.)
Power:	(a) 115/200 volts 3-phase 4-wire 400 Hz - 200 watts (max) (b) 28 VDC - 2A Peak
Rotor Types:	Designed to satisfy Exp. requirements.

TITLE: REFRIGERATOR/FREEZER

STATUS: FABRICATION

CATALOG NUMBER: J044

DEVELOPMENT CENTER: JSC

PART NUMBER: JSC SED46102000-301

DESCRIPTION: The refrigerator/freezer is an active unit with a temperature range from  $-22^{\circ}$  to  $+10^{\circ}$  C. It will be stowed in the Spacelab in a standard Spacelab single rack. The refrigerator/freezer will be used to cool blood, body fluids, and cell samples as well as solutions and fluids intended for injection. It may also be used to house small animals, to incubate amphibian zygotes, and to stow animal food supplies. The refrigerator/freezer will be designed to accept experiment racks, shelves, and containers for a variety of Life Sciences experiments.

INVENTORY: Five Flight Units

TECHNICAL SPECIFICATIONS:

Temperature range:	$-22^{\circ}$ to $+10^{\circ}$ C (digital display).
Accuracy:	$\pm 1^{\circ}$ C.
Freon Type:	R-502
Cooling Capacity:	> 700 BTU/hr. at $4^{\circ}$ C > 400 BTU/hr. at $-22^{\circ}$ C

Monitoring Capabilities:

The following controls and displays are available at the front of the unit and provide the ability to monitor the refrigerator/freezer.

1. Emergency On Switch - This two position switch is used to actuate the emergency on (backup) mode. The switch, in the on position, causes spacecraft power to be applied directly to the compressor and cooling fans while removing the power supply and all normal control elements from the circuit. The compressor runs continuously when operating as a freezer and is controlled in the  $3^{\circ}$  to  $7^{\circ}$ C range when operating as a refrigerator. This switch is operated by the Astronauts only after a failure in the normal system.
2. Refrigerator/Freezer Selector Switch - This switch is used to designate operation of the unit as a refrigerator or as a freezer when in the backup mode. This switch will be set by the ground crew prior to launch.
3. Momentary Temperature Readout Switch - This pushbutton switch allows for momentary powering of the thermometer so an inside temperature reading can be obtained when the refrigerator/freezer is in its emergency on mode. This switch is operated by the Astronauts as required during operation in the emergency on mode.

4. Acceleration Switch Disable - This two position toggle switch effectively removes the acceleration switch from the circuit. It will be activated only by the Astronauts in the event that the acceleration switch malfunctions.
5. Thermometer - This digital readout displays inside air temperature (over the range  $\pm 99.9^{\circ}\text{C}$ ) at all times the unit is on.
6. Comparator - The comparator is a dual set point controller. The two set points select the temperature at which the compressor turns on and off respectively. The set points will be selected by the ground crew prior to launch. The crew members may change the set points if specified by Mission Requirements.
7. Indicator Lights - Three lights on the front panel are status indicators.
  - \*Compressor On - Green light is on when voltage is applied to the compressor.
  - \*Low Freon Pressure - Amber light is on when freon pressure in system is below a present limit ( 80 PSIG).
  - \*Housing Pressure - Amber light is on when the pressure in the secondary containment falls below a preset value. This indicates that the freon in the refrigerator/freezer has leaked into the secondary containment.
8. Elapsed Time Meter - This is a digital meter that indicates total compressor run time to the nearest hour.
9. Data Connector - The data connector on the front panel is for ground crew use. It should not be accessed by the crew members unless instructed by Mission Control.
10. Door Operation - The door is mounted with its hinges on the left or right by the ground crew prior to installation on the Spacelab.
  - To open the door pull up on flap 50° to retract the bolts that secure the door.
  - To close the door, exert force on the door until the two securing bolts click into place as indicated by bright spot at upper end of securing bolts.
11. Temperature Recording - Internal temperature of cooled volume will be recorded at a rate of one sample per 7.5 minutes. This is automatically accomplished by use of an "Ambient Temperature Recorder" located in the cooled volume prior to launch. No operator intervention is required.



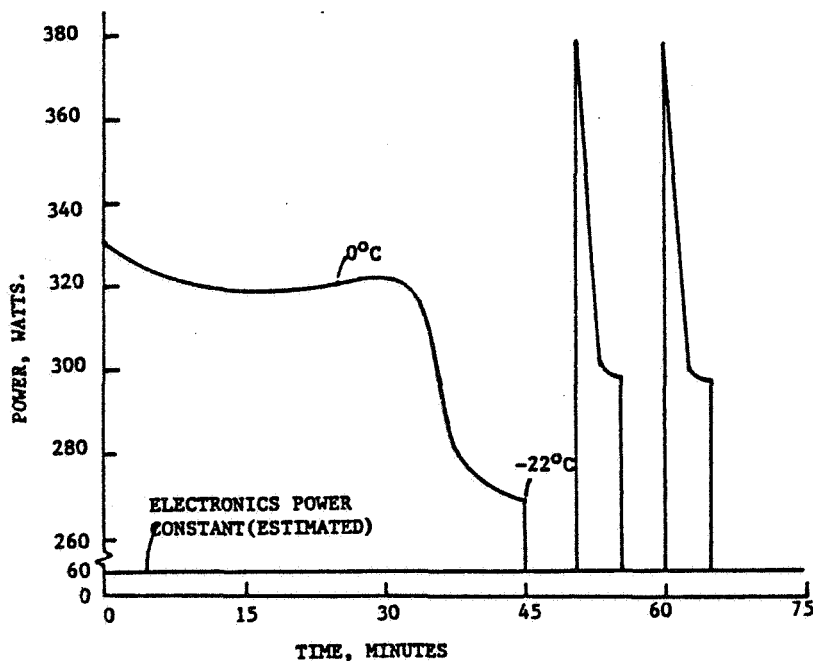
# ENGINEERING DATA:

Weight:	< 70 kg.
Power:	28 VDC, 200 W. (Freezer Mode, Avg.)
Dimensions, external:	86.4 L x 48.2 W x 80 H cm.
Volume, internal (min.):	2.5 ft <sup>3</sup> .
Volume, external:	11.ft <sup>3</sup> max.
Panel units:	18.

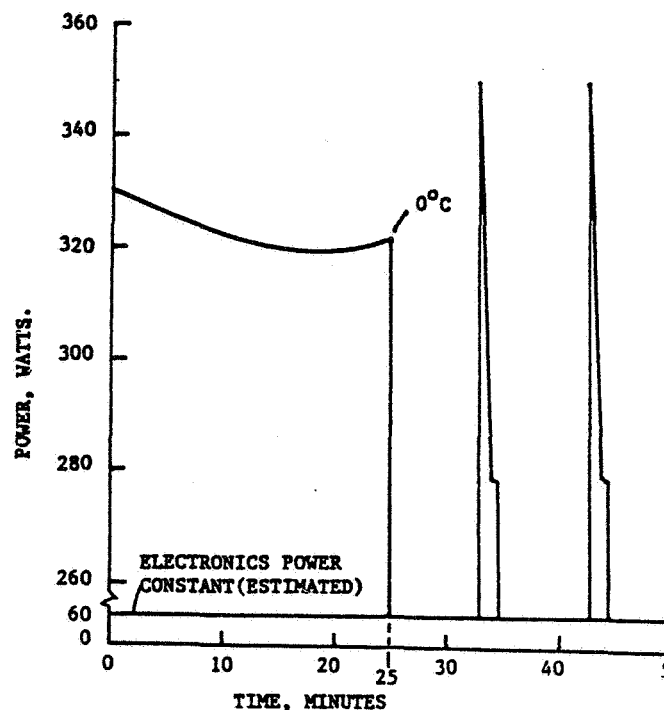
## POWER PROFILE:

The power requirement at an ambient temperature of  $\leq 80^{\circ}\text{F}$  will be followed with 28 VDC + 4 VDC.

0 - 10 seconds current	$\leq 25$ Amps
10 - 120 seconds	$\leq 18$ Amps
Steady State	$\leq 16$ Amps
Average Power	$\leq 200$ Watts
Steady State Duty Cycle Without Load	35% at $-22^{\circ}\text{C}$ 10% AT $4^{\circ}\text{C}$

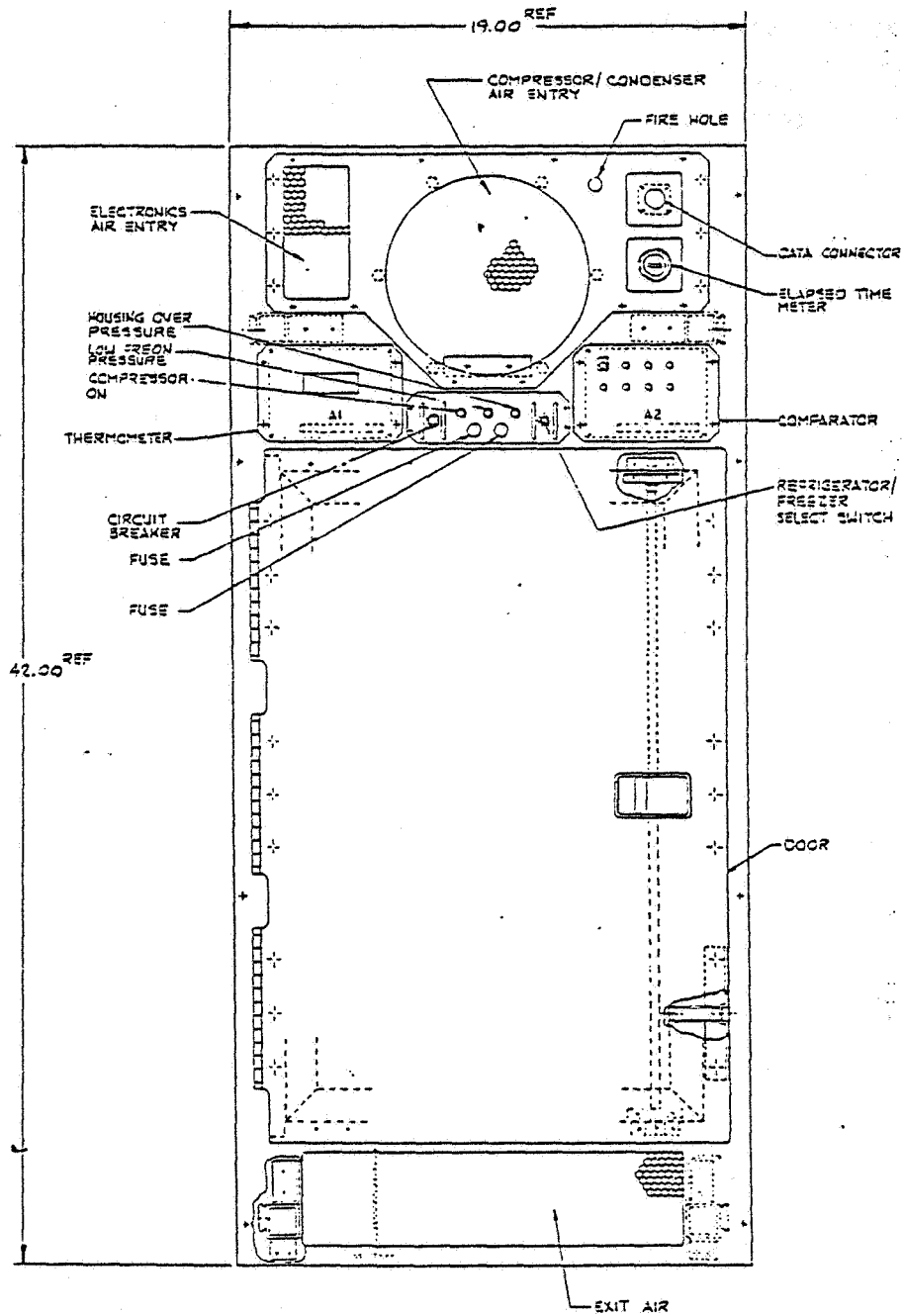


POWER PROFILE OF SPACELAB FREEZER.



POWER PROFILE OF SPACELAB REFRIGERATOR

# Refrigerator/Freezer



FRONT PANEL LAYOUT  
LSLE REFRIGERATOR/FREEZER

TITLE: ECHOCARDIOGRAPH

STATUS: FABRICATION

CATALOG NUMBER: J046

DEVELOPMENT CENTER: JSC

PART NUMBER: SED46101851-301

DESCRIPTION: This device is a state-of-the-art echocardiograph imaging system. The device uses ultrasound, computer image enhancement and data storage techniques to generate a two (2) dimensional real-time video display of cardiac parameters. The LSLE item will be a ruggedized commercial system built to spacecraft standards. Ultrasound imaging is a field where the technology is changing rapidly. Prime consideration is the ease with which new techniques can be incorporated into the system in the future (upward compatibility).

The echocardiograph will be rack mounted in Spacelab. The system will incorporate an operator video display, image processor unit, digital scan converter, physiological signal amplifier.

INVENTORY: Two Flight Units

TECHNICAL SPECIFICATIONS:

Image resolution:	1.5mm axial, 3.4mm @ 7.5cm
Range:	1cm to 21 cm tissue depth
Field of view:	Sector angle 80° minimum
System Mode:	M Single dimension intensity B Two dimensions

ENGINEERING DATA:

Dimensions:	61 L x 48.2 W x 71 H cm
Weight:	91 kg
Power:	700 W
Inputs:	Spacecraft Video RS-170 Video (CCTV Mode) Commercial Interfaces to GSE accessories such as hard copy camera and image analysis computer.
Outputs:	Spacecraft Video RS-170 Video Commercial Interfaces to GSE accessories
Physio. Amp Module:	Lead 2 ECG Heart sound or pulse aux. input.

TITLE: EVENT TIMER

STATUS: CONCEPTUAL

CATALOG NUMBER: J047

DEVELOPMENT CENTER: JSC

PART NUMBER: TBD

DESCRIPTION: The event timer is a device that measures and displays time. Capabilities of the event timer include measuring the time of an occurrence within the total event, and elapsed time of the event in a numerically increasing mode.

INVENTORY: TBD

TECHNICAL SPECIFICATIONS:

Maximum amount of time to be measure:	12 hours
Accuracy:	<u>+5</u> seconds
Frequency of observations:	Continuous display of occurrence and event timer
Units:	Hour:Minute:Second
Mobility:	Fully portable within the spacecraft
Audible signals:	Capability of setting at fixed (e.g. every 30 sec., 1 min, 1 hr., etc)
Time display:	Count up/Count down

ENGINEERING DATA:

Dimensions:	12.1 L x 6.9 W x 4.1 H cm (max)
Weight:	0.2 kg (max)
Power:	Battery

TITLE: MINI SPECTROPHOTOMETER

STATUS: COMPLETE

CATALOG NUMBER: J048

DEVELOPMENT CENTER: JSC

PART NUMBER: JSC SDD46100187-301

DESCRIPTION: The mini spectrophotometer is compact, lightweight, and rugged enough to be used under adverse field conditions.

It features a built-in battery power supply for use away from conventional power sources. The instrument is equipped with a high quality diffraction grating and a monochromator unit and has been modified to provide digital display of absorbance of the selected sample.

INVENTORY: Three Flight Units

TECHNICAL SPECIFICATIONS:

Wavelength Range:	400 - 800 nanometers
Wavelength Accuracy:	<u>+3</u> m at 546 nanometers
Wavelength Readability:	0.5 nanometers
Spectral Slitwidth:	20 nanometers

ENGINEERING DATA:

Dimensions:	15.5 L x 9 W x 4.8 H cm
Weight:	.46 kg
Power:	battery

MINI-SPECTROPHOTOMETER



TITLE: CASSETTE DATA TAPE RECORDER

STATUS: COMPLETE & REDESIGN

CATALOG NUMBER: J051

DEVELOPMENT CENTER: JSC

PART NUMBER: CDTRII-100-1, CDTRII-100, CDTRIII-XXX

DESCRIPTION: The data recorder is an eight channel battery-powered recorder.

Model II: Four units complete. S/N 001: Six analog-digitized channels, two analog channels. S/N002-004: Eight analog-digitized channels. Loop for 0.6 x 7.0 cm belt.

Model III: Four units on order. Eight analog-digitized channels, one of which is switchable to record analog signals directly, one to record digital input.

INVENTORY:	CDTR II - 100-1	One Flight Unit
	CDTR II - 100	Three Flight Units
	CDTR III - XXX	Four Flight Units

#### TECHNICAL SPECIFICATIONS:

Recording time:	8 hrs. for Model II at 100 Hz sampling rate.
	8/4/2 hrs. for Model III at 100/200/400 Hz sampling rate.
Digital density:	5866 bits/inch/track.
Data word length:	10 bits + 1 bit parity.
Dynamic range:	60 dB.
Encoding:	Miller.
Error rate:	2 bits, max., in $10^4$ .
Tape Type:	Phillips-type cassette 440 ft. Dual independent pressure pads.
Bandwidth:	Analog-digitized    Analog-direct
100 Hz sampling (3/16 ips)	DC-40 Hz            75-1200 Hz
200 Hz sampling (3/8 ips)	DC-80 Hz            75-2400 Hz
400 Hz sampling (3/4 ips)	DC-160 Hz           75-4800 Hz

ENGINEERING DATA:

Dimensions in cm:

Model II 13.7 L x 13.4 W x 6.24 H  
Model III 16.9 L x 14.0 W x 6.9 H

Weight (includes battery):

Model II 1.09 kg.  
Model III TBD; less than 1.35 kg.

Power:

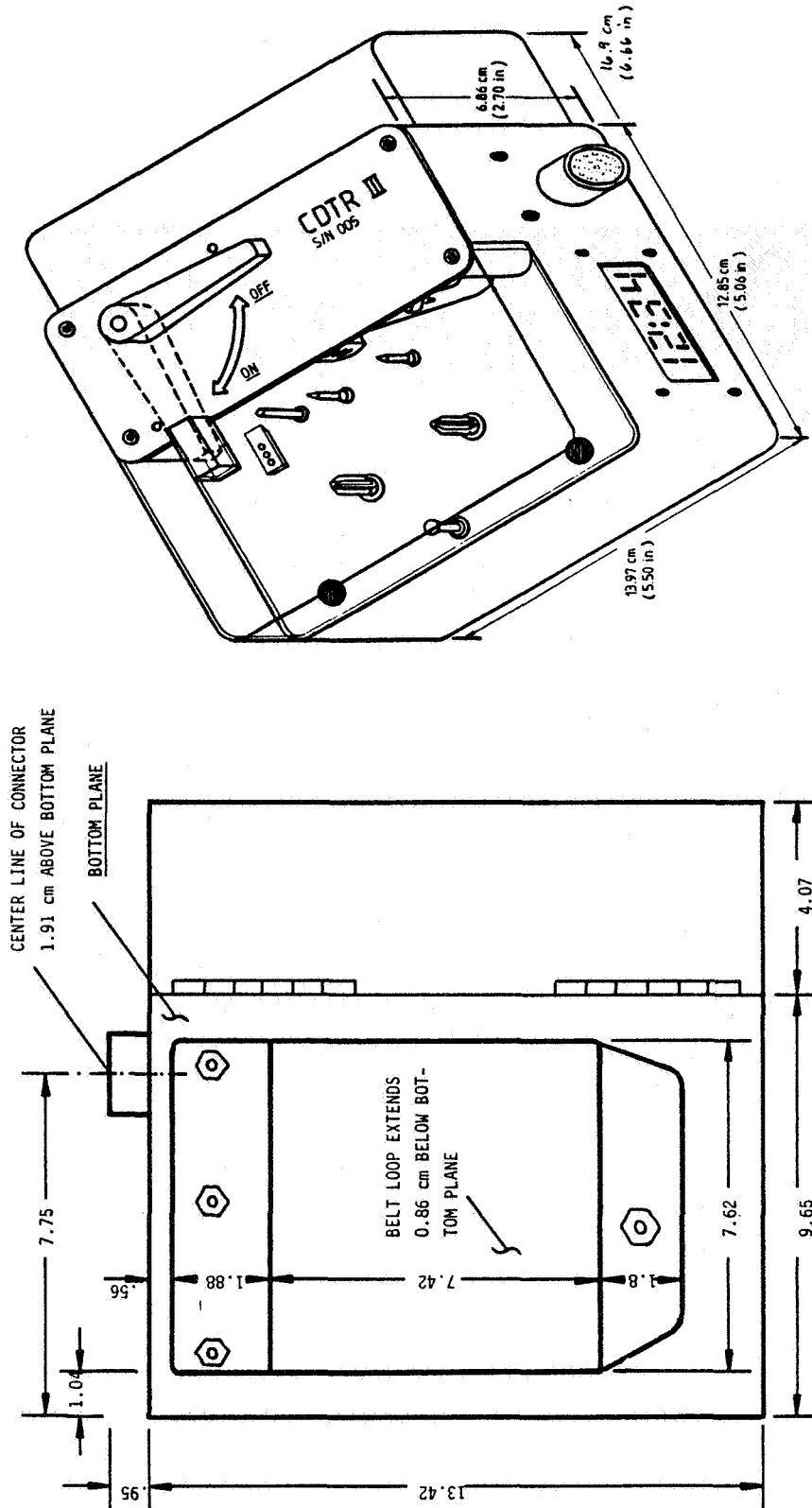
Lithium battery pack SED46100587-301.  
Minimum of 60 hours operating time.



## Cassette Data Tape Recorder



# Cassette Data Tape Recorder, Model III



- NOTES:
1. ALL DIMENSIONS GIVEN ARE IN CENTIMETERS.
  2. CASE EXTENDS 6.10 cm ABOVE BOTTOM PLANE.
  3. UNIT WEIGHS APPROX. 1090 g (INCL. 225 g BATTERY).

CASSETTE DATA TAPE RECORDER WITH BELT LOOP, BOTTOM VIEW  
(P/N CDTR II-100, S/N 002, 003, 004)

Cassette Data Tape Recorder, Model III -- Concept

TITLE: ORBITER REFRIGERATOR/FREEZER

STATUS: DESIGN

CATALOG NUMBER: J052

DEVELOPMENT CENTER: JSC

DESCRIPTION: The refrigerator/freezer is an active unit with a temperature range from  $-22^{\circ}\text{C}$  to  $+10^{\circ}\text{C}$ . It will be mounted in one of 4 location on the middeck of the orbiter in place of 2 stowage lockers. The locations are MF14E and G, MF28E and G, MA9F and G, MA16F and G. The refrigerator/freezer will be used to cool blood, body fluids, and cell samples as well as solutions and fluids intended for injection. It may also be used to house small animals, to incubate amphibian zygotes, and to stow animal food supplies. The refrigerator/freezer will be designed to accept experiment racks, shelves, and containers for a variety of Life Sciences experiments.

INVENTORY: Two Flight Units

TECHNICAL SPECIFICATIONS:

Temperature range:	$-22^{\circ}$ to $+10^{\circ}\text{C}$ (digital display)
Accuracy:	$+1^{\circ}\text{C}$
Freon Type:	R-502
Cooling Capacity:	
$4^{\circ}\text{C}$	700 BTU/Hr.
$-22^{\circ}\text{C}$	-400 BTU/Hr.

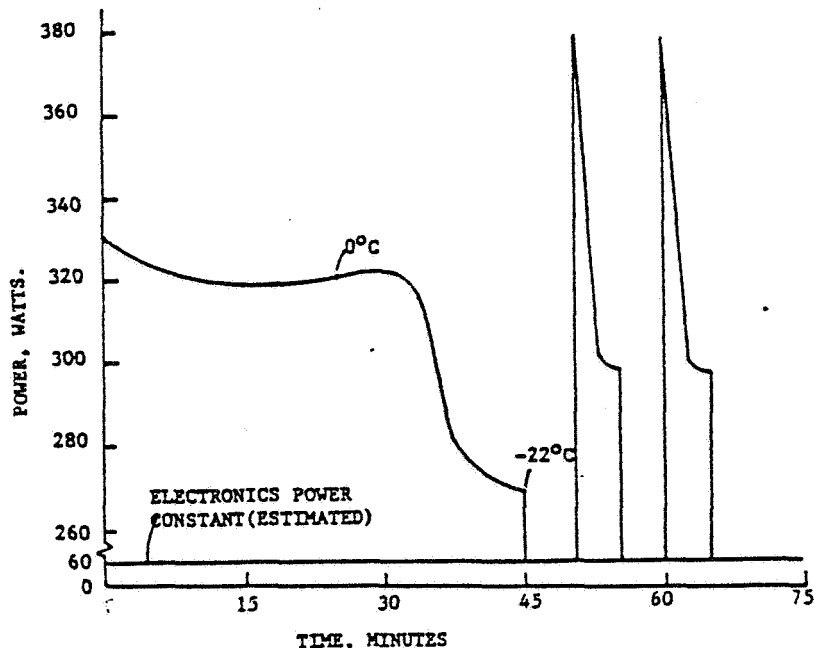
# ENGINEERING DATA:

Weight:	< = 90 lbs
Power:	28 VDC, 200 W.
Dimensions, external:	23.8" H x 18.125" W x 20.3" D cm.
Volume, internal (min.):	1.27 ft <sup>3</sup>
Volume, external:	5.1 ft <sup>3</sup> max.

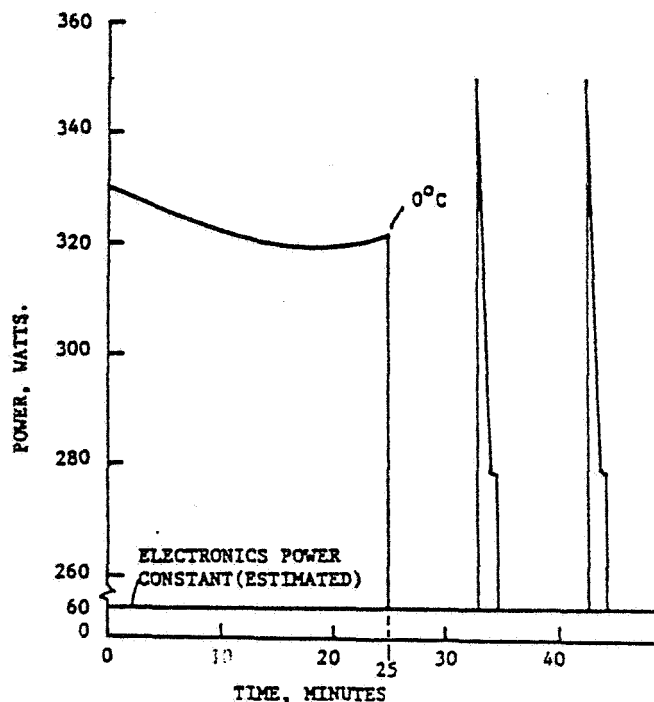
## POWER PROFILE:

The refrigerator/freezer will operate using two utility outlet on the middeck. Outlets on the same bus must be capped due to the high power requirements. The two incoming utility cables will be diode isolated into one line. This line will have a current limiter on it of 18 amps to protect orbiter breakers.

28 VDC + 4 VDC  
 0 - 120 Sec. 18 Amps  
 Steady State 16 Amps  
 Avg. Power 220 Watts  
 Steady State Duty Cycle  
 No cooling load  
 35% @ - 22°C  
 10% @ 4°C



POWER PROFILE OF SPACELAB FREEZER.



POWER PROFILE OF SPACELAB REFRIGERATOR

The following controls and displays are available at the front of the unit and provide the ability to operate and/or monitor the refrigerator/freezer.

1. Emergency On Switch - This two position switch is used to actuate the emergency on (backup) mode. The switch, in the on position, causes spacecraft power to be applied directly to the compressor and cooling fans while removing the power supply and all normal control elements from the circuit. The compressor runs continuously when operating as a freezer and is controlled in the 3° to 7°C range when operating as a refrigerator. This switch is operated by the Astronauts only after a failure in the normal system.
2. Refrigerator/Freezer Selector Switch - This switch is used to designate operation of the unit as a refrigerator or as a freezer when in the backup mode. This switch will be set by the ground crew prior to launch.
3. Momentary Temperature Readout Switch - This pushbutton switch allows for momentary powering of the thermometer so an inside temperature reading can be obtained when the refrigerator/freezer is in its emergency on mode. This switch is operated by the Astronauts as required during operation in the emergency on mode.
4. Acceleration Switch Disable - This two position toggle switch effectively removes the acceleration switch from the circuit. It will be activated only by the Astronauts in the event that the acceleration switch malfunctions.
5. Thermometer - This digital readout displays inside air temperature (over the range  $\pm 99.9^{\circ}\text{C}$ ) at all times the unit is on.
6. Comparator - The comparator is a dual set point controller. The two set points select the temperature at which the compressor turns on and off respectively. The set points will be selected by the ground crew prior to launch. The crew members may change the set points if specified by Mission Requirements.
7. Indicator Lights - Three lights on the front panel are status indicators.
  - \*Compressor On - Green light is on when voltage is applied to the compressor.
8. Alarm
  - \*Low Freon Pressure - Amber light is on when freon pressure in system is below a present limit ( 80 PSIG).
  - \*Housing Pressure - Amber light is on when the pressure in the secondary containment falls below a preset value. This indicates that the freon in the refrigerator/freezer has leaked into the secondary containment.
  - \*Audio - Frequency: 1000  $\pm$  100 Hz Square Wave
    - Duration: 250 MS On, 250 MS Off, 250 MS ON, 250 MS Off, 250 MS On. The above sequence will be repeated once each 30 seconds until the alarm is acknowledged or the out of tolerance condition is removed.
    - Loudness: 80-90 Db measured at 18" from the sound source.

# ORBITER REFRIGERATOR/FREEZER CONCEPT

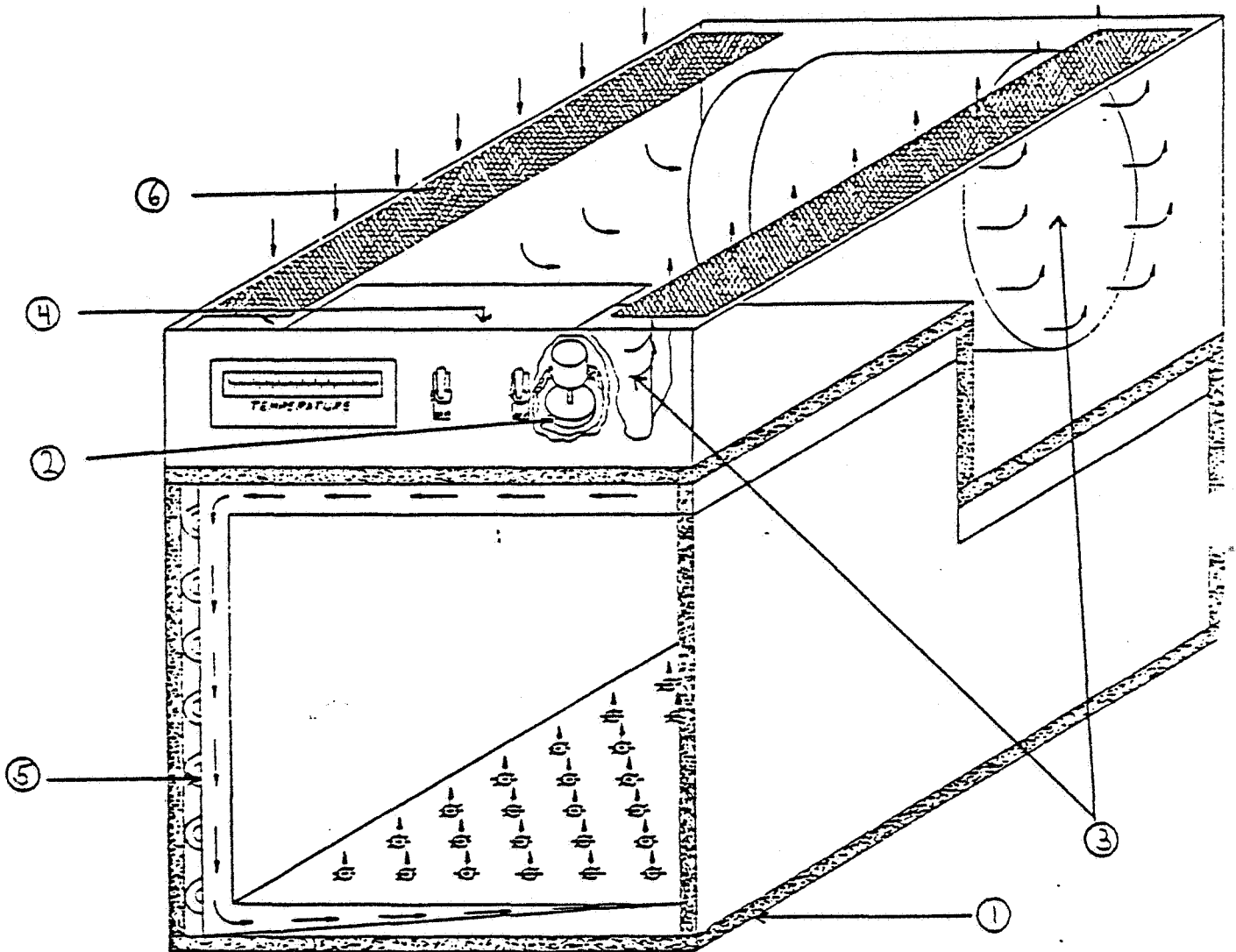


Figure 1

#### NOTES FROM FIGURE 1

1. Urethane foam contained by either AL, Florel, Kel-F or Cohrlastic 9255.
  2. Squirrel cage fan with screen (.25 in. Hexagon, Wire size .035 in.)
  3. Rotary duct fans for electronics and compressor, condenser housing
  4. Electrical duct.
  5. Evaporator which is double contained.
  6. Screen (inlet and outlet) for cabin air flow (screen size .25 in. Hexagon, wire size .035 in.)
- A. All three of the materials are NASA approved as a flame retardent to protect the urethan from fire.
- B. Duct work to separate air flow between the electronics and compressore,condenser housing is not shown for clarity of the drawing but will be implemented.

TITLE: KEYBOARD/DISPLAY TERMINAL

STATUS: COMPLETE

CATALOG NUMBER: J053

DEVELOPMENT CENTER: JSC

PART NUMBER: SED46101900-301

DESCRIPTION: The keyboard/display terminal is a character-oriented data terminal for interactive computer/communication applications. The communications interface is EIA RS-232C compatible with variable baud rates from 300 to 9600 baud. The keyboard is a typewriter type and the display has 64 characters. The unit is low power, small, portable, and has been modified for STS compatibility.

INVENTORY: Four Flight Units

#### TECHNICAL SPECIFICATIONS:

MECHANICAL:	Hand held or attachable to the rack.
STOWAGE:	Stowed for launch and reentry in stowage locker.
ELECTRICAL:	Cable from rack interface panel for power and data.
DATA INTERFACE:	Standard RS-232 Serial asynchronous ASCII.
BAUD RATES:	Selectable baud rates of 300, 1200, 2400 and 9600.
KEYBOARD:	53 Key alphanumeric keyboard, membrane switches with audible key-click for tactile feedback.
DISPLAY:	Two line 64 character LCD Display, backlighted with an electroluminescent panel for low light level operation.



ENGINEERING DATA:

Size 30.7 W x 17.5 D x 4.4 H cm.

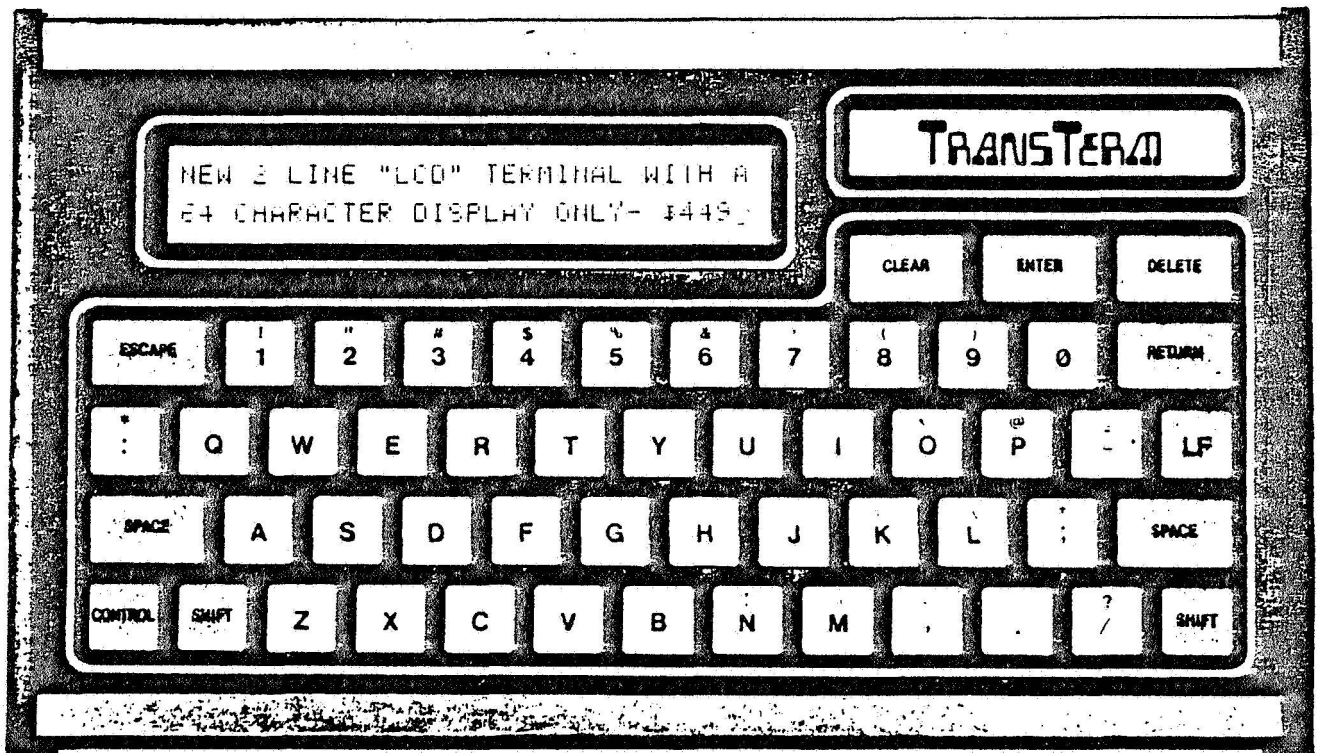
Volume: .085 ft.<sup>3</sup>

Weight: 1.36 kg.

Power: 28 VDC

Energy: 10 Watts DC

# Keyboard/Display Terminal



TITLE: TISSUE CULTURE INCUBATOR

STATUS: COMPLETE

CATALOG NUMBER: J055

DEVELOPMENT CENTER: JSC

PART NUMBER: SED46101750-301

DESCRIPTION: This small tissue culture incubator capable of maintaining  $37^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$ . It can house four 15ml cultures. The culture chambers are made of teflon and glass and are equipped with a septum permitting the addition of material in flight via syringes also stored in the incubator. The syringes may be either modified 5 ml or standard syringes. Volume expansion of the culture vessels is achieved by a teflon sleeved piston arrangement in which the septum is housed. Either spacecraft or battery power can be used. The incubator can be mounted in a standard 18 inch electronics (or experiment) rack or be carried alone in a battery mode removed from the rack.

INVENTORY: Two Flight Units

ENGINEERING DATA:

POWER INPUT:

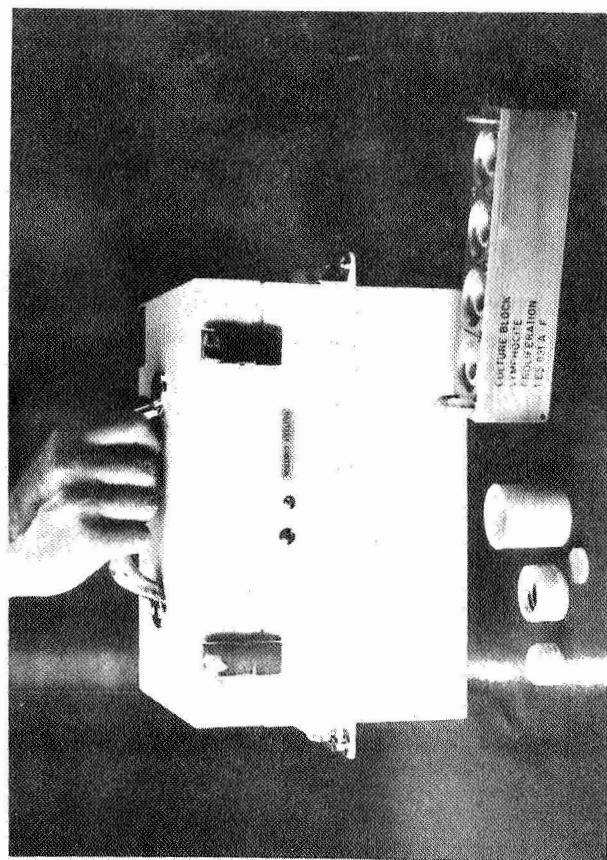
28VDC, 0.5 amps when attached to spacecraft power. The battery pack contains sixteen 1.5 volt AA.

SIZE:

17.4 x 48.2 x 22.1 cm when rack mounted, 24.8 x 30.4 x 18.6 when removed.

WEIGHT:

6 Kg Total



TO BE USED FOR LYMPHOCYTE  
PROLIFERATION EXPERIMENTS ON  
SL-1 & SL-4



TITLE: MIDDECK ROTATOR

STATUS: FABRICATION

CATALOG NUMBER: E033

DEVELOPMENT CENTER: JSC

PART NUMBER: N/A

DESCRIPTION: The Middeck Rotator will consist of a servo controlled DC motor-driven rotating chair and pedestal assembly, a manually operated programmable control console to vary the rotational velocity and acceleration of the chair. This system shall be used to conduct vestibular investigations aboard the Space Shuttle Orbiter Middeck.

INVENTORY: Two Flight Units

TECHNICAL SPECIFICATIONS:

The system (chair/pedestal assembly and drive motor controller) shall be designed for operations in 0g and 1g environments. Overall system requirements are as follows:

Angular velocity:	0-60 RPM (0-360 DEG/SEC)
Direction:	CW, CCW
Accuracy (of command input):	1 deg/sec for 0-49 deg/sec <u>+2%</u> for 50- 360 deg/sec
Angular acceleration:	0-6 rad/sec <sup>2</sup> (0-344 deg/sec <sup>2</sup> )
Max at all speeds up to 60 RPM	
Direction:	CW, CCW
Accuracy (of command input):	<u>+1.0</u> deg/sec <sup>2</sup> or <u>+2%</u> whichever is greater
Angular deceleration:	0-3/49 rad/sec <sup>2</sup> (0-200/sec <sup>2</sup> )
Direction:	CW, CCW
Accuracy (of command input):	<u>+1.0</u> deg/sec <sup>2</sup> or <u>+2%</u> whichever is greater
Resolution (input command):	
Velocity:	0.05 RPM
Acceleration:	0.05 rad/sec <sup>2</sup>
Deceleration:	0.05 rad/sec

ENGINEERING DATA:

Voltage:	28 VDC +4 -5
Power:	220 W max.
System weight:	90 lbs max (Est)
System rotational inertia (subject, chair/pedestal assembly): Withstand 125 lb. kick load applied to chair/pedestal assembly	2 ft-lb -sec <sup>2</sup> max
Volume:	4.45 ft <sup>3</sup> (Est.)

Accommodate 95th percentile subject seated in the chair

Subject in yoga position only

No backlash/jerk felt by subject, when changing angular velocity or  
Slip rings assembly 16 pairs - 14 data signals at 2 amps.  
2 power at 10 amps min.

A velocity output port. It will be a 0-10 volt signal which is updated at a  
design goal rate of 100 times per second.

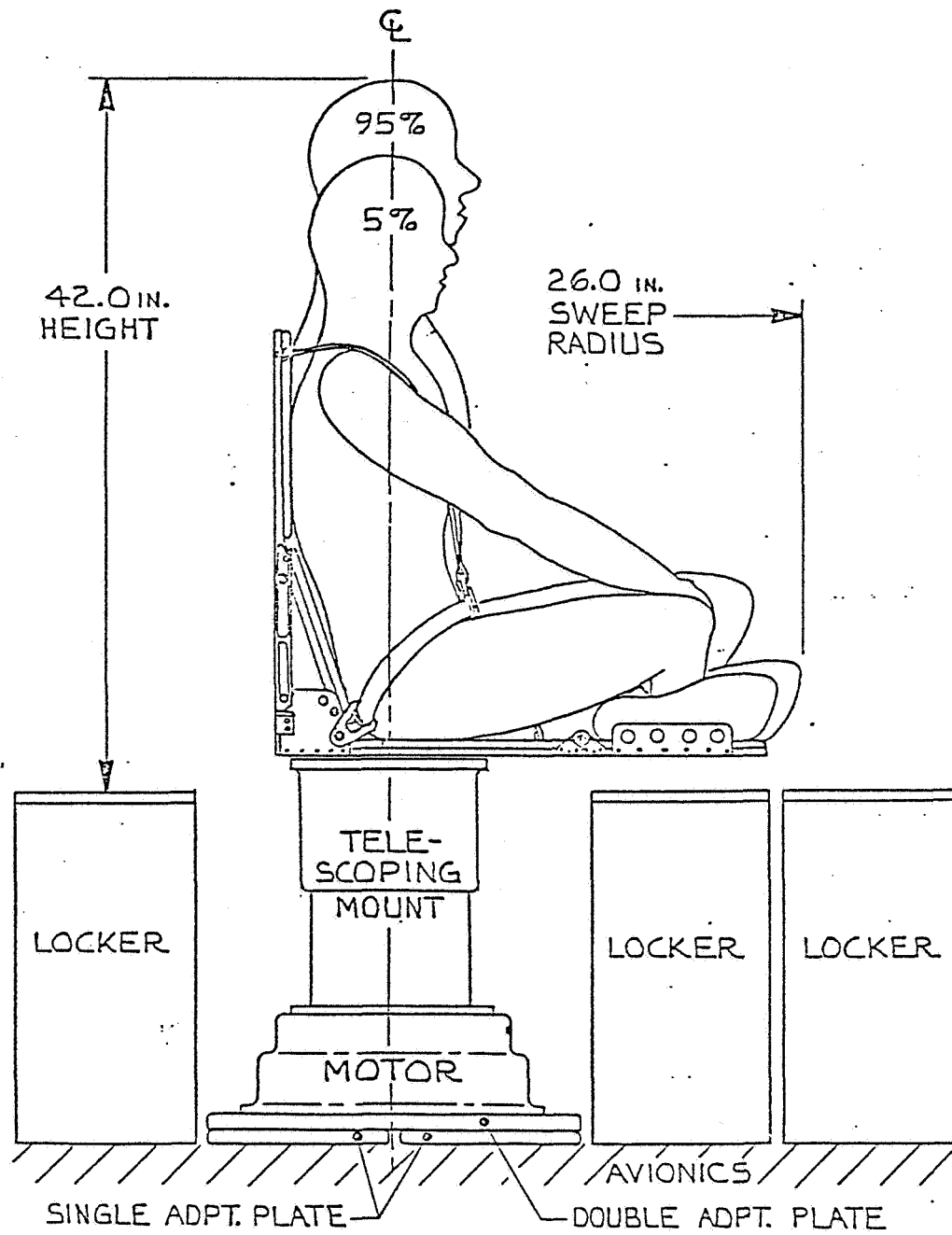
An emergency stop feature located on the controller

A cadance signal in the form of an audible beep. Signal range: 1000 Hz to  
2000 Hz.

A start/stop switch and an on/off power switch on the controller

Controller size: 12" L x 12" W x 5" H max.

ROTATING CHAIR  
UNSTOWED



LS-30013 LSLE DESCRIPTIONS

SE/W. Bush

J. Evans

R. Clark, Ph.D.

M. Buderer, Ph.D.

STI Center/MATSCO (20)

SE2/W. Feddersen, Ph.D. (3)

M. McEwen, Ph.D.

P. Lafferty (3)

SE3/J. Bost

B. French

B. Westover

D. White (4)

SE4/R. Kirby

J. Lintott (3)

B. McAllum (3)

T. White (3)

E. Peck (3)

R. McKinney (3)

W. Young (3)

L. Newkirk (3)

D. Harris (3)

SE5/F. Spross

H. Huber

P. Bahr

W. Davis

SD4/N. Cintron, Ph.D.

ARC/LBE D. Sinnott

D. Buckendahl

A. LaBoy

NASA HQS.

EBF3/S. Benson/MATSCO

MATSCO

Bldg. 36/P. Grounds

J. Lake

J. Bielat

L. Weinert

D. Geaslin

MATSCO

Agena/J. Tyler (4)

M. Rassas

D. Grounds

R. Schwarz

G. Salinas

C. Nash

H. Spencer

T. Belver

R. Portier

J. Bahr

M. Yalcinkaya

P. Van Nordstrand

D. Skinner

J. Sackett

A. Deasi

A. Hye

T. Martin

L. Gust

J. Carney

R. Gilbreth